

Colorado Nonpoint Source - FFY2013  
Implementation Project Proposal and PIP Form

<b>Project Title</b>	Bullion King Mine Waste Remediation
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**1.0 - Project Proposal Summary**

<b>Sponsor</b>			
Organization Name	San Juan RC&D		
E-mail address	Personal Email/Ex. 6		
Mailing Address	Personal Address/Ex. 6		
City, State and Zip			
Telephone Number	Tax ID Number	Nonresponsive	

<b>Project Coordinator or Primary Contact</b>	
Name	William Simon
Title	Coordinator
E-mail Address	Personal Email/Ex. 6
Mailing Address	Personal Address/Ex. 6
City, State and Zip	
Telephone Number	Personal Phone/Ex. 6

<b>Project Funding</b>
CO NPS Funds Requested \$221,355 + Match (cash/in-kind) \$244,544 = Total Project Cost \$465,899
Federal Funds - Federal Cooperator Contribution (please do not include in the total) \$36,000

<b>Project Start Date</b>	April, 2014	<b>Project End Date</b>	June, 2017
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<b>Project Location</b>	
WQCC Regulation River Basin	San Juan and Dolores River Basins (WQCC Regulation #34)
Sub-Watershed(s)	Animas River
HUC(s) - 8 or 12 digit USGS Hydrologic Unit Codes	14080104
Impaired Segment(s) Waterbody ID(s)	Mineral Creek COSJAF08 and 09; Animas River COSJAF04, 04b and 3C

<b>NPS Pollution Source categories to be addressed (Check all that apply)</b>			
	Agriculture		Silviculture
	Habitat Modification (drainage/filling wetlands, stream bank destabilization)		Hydrologic Modification (changes to water flow as in reservoir, diversions, etc.)
	Urban runoff/Stormwater		Groundwater Loading
x	Mining		Natural Sources
	Construction		Other:

<b>NPS Pollutants to be addressed (Check all that apply)</b>
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	Excess Nitrogen		Pesticides
	Excess Phosphorus		Selenium
	Sedimentation		Temperature
	Pathogens/Bacteria	x	pH
x	Metals		Habitat impact
	Low dissolved oxygen		Other:
Estimate Load Reduction, if checked for excess nitrogen, excess phosphorus and/or sedimentation			
# pounds of nitrogen reduced by project		Reference:	
# pounds of phosphorus reduced by project		Reference:	
# tons of sediment load reduced by project		Reference:	
# pounds of metals reduced by project Al-90#/yr; Cd -5.4#/yr.; Cu- 12.6#/yr.; Fe – 8950#/yr.; Mn – 171#/yr.; Zn – 566#/yr.		Reference: Animas UAA	
# pounds of selenium reduced by project		Reference:	

**Project Description:**

This project will develop and implement a mine waste remediation plan for the Bullion King mine which is a significant source of heavy metals and acid that impacts Mineral Creek, a major tributary to the Animas River. Bullion King has been fully characterized and determined to be the highest ranking remaining mine waste site that contributes metals and acidity to Mineral Creek. Several previous remediation projects in the Mineral Creek watershed have resulted in near attainment of water quality goals. Successful reduction of metal contributions from the Bullion King should result in compliance with adopted water quality standards. The project, from design to construction completion, is expected to take two summer seasons. The site will be monitored before and after remediation to determine effectiveness of the implemented BMP's. The Animas River Stakeholders Group (ARSG) will showcase the site to demonstrate BMP applicability and cost effectiveness.

**2.0 - Statement of Need**

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After several years of remediation of mine sites throughout Mineral Creek, this project is anticipated as being the last mine waste site needing remediation in order to bring Mineral Creek into attainment of the State's adopted numerical standards for Mineral Creek.

### **2.1- General Watershed Information**

The upper Animas basin comprises 186 square miles of highly mineralized, high altitude mountains which are the headwaters to the Animas River (Figure 1). The watershed elevation varies from over 13,000 feet at its headwaters to 6,600 feet in Durango, CO. Geology is dominated by the volcanically metal rich Silverton Caldera. The Upper Animas Watershed is comprised of 3 sub-basins, the Upper Animas Mainstem, Cement Creek, and Mineral Creek.

Land use in the upper watershed above Silverton is primarily mine claims and forest. Mineral Creek basin has numerous patented mine claims and related mine wastes and draining adits scattered throughout. Over 86 % of the land is public lands administered by the BLM and/or Forest Service. In recent decades tourism is San Juan County's primary industry followed by historical preservation (of mine related cultural features) and mine site remediation. Erosion occurs mostly on disturbed sites related to mining, grazing, and road maintenance. The only agriculture in the Upper Animas basin, including Mineral Creek, is limited to grazing by cattle and sheep. There have been no silvicultural practices in the last 50 years, except for a few small scale individual permits. The sole municipality in the Upper Animas is Silverton which obtains its domestic water from two small, pristine creeks that are only slightly mineralized and contain no significant historic mine sites. Bear Creek, within the Mineral Creek Watershed, is one of these creeks. Discharging into Mineral Creek at its confluence with the Animas River, below the Mineral Creek gauge (M34) is Silverton's permitted wastewater treatment plant.

Several nonpoint source (NPS) projects have been completed in Mineral Creek. The Koehler tunnel, highest priority for abandoned mine drainage, was funded and bulkheaded by mining company participants. The USFS, the Southwestern Water Conservation District (SWCD), and the NPS program collaborated to purchase all water rights to the Carbon Lakes trans-basin diversion ditch. Some of those rights have since been dedicated to Mineral Creek as "in-stream flow" with the rest reserved for "environmental purposes" by the Colorado Water Conservation Board. That project reduced infiltration into the Koehler tunnel, thus reducing its acidic discharge, and redirected a significant clean water resource back into Mineral Creek. The high elevation ditch has since been successfully restored to its original contours and vegetation of over 60 species of alpine plants. Two US Forest Service priority mine waste sites have also been addressed. Other NPS Mineral Creek projects have included bulkhead pressure grouting to reduce leakage from within the Koehler tunnel, and the removal, consolidation, and neutralization of mine wastes and site restoration at six priority mine waste sites, most recently at the Silver Ledge mine site.

### **2.2 –Waterbody Description**

The Upper Animas (HUC code 14080104) watershed is dominated by high gradient, high elevation, snow fed streams with stream orders of 1 to 4. Stream channels are generally stable except in a one mile stretch of the Eureka floodplain where there is extensive braiding. The Animas River has been significantly impacted by metal contamination from both historic mining and natural geological processes. Source waters have high metal content and acidity leaching through natural processes and anthropogenic alterations of the host rock. Stream substrates are often heavily impacted by the accumulation of oxyhydroxide precipitates of Aluminum and Iron with various other metals adsorbed to these precipitates, thus reducing aquatic habitat. There are no fish in the Mineral Creek mainstem.

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Located in Mineral Creek (get HUC 12), the Bullion King minewastes lie immediately adjacent to the order 1 headwaters of Porphory Gulch. The stream's geomorphology varies from cascade to drop pool. The stream courses over exposed glaciated bedrock for most of its short (ca. 1 mile) length. The stream runs year round but winter flow is reduced to a trickle. Water quality samples taken in the 1990's at Porphory Gluch's confluence with Mineral Creek (order 3) indicated metals and acidity met TVS. However the Mineral Creek sample site M07 approximately ¼ mile below M06 always vastly exceeds TVS. It was only after further characterization of the mine wastes, including volume estimates, observations, and leach testing that it became apparent that large loads of metals are carried down the steep and mostly inaccessible Porphory Gulch during and after storm events.

### 2.3 – Type of Water Quality Problem including Sources

The Animas River watershed is heavily impacted by toxic metals and acid derived from both natural and historic mining related sources. The entire basin is highly enriched with heavy metals that leach from natural exposure to the elements, known as “acid rock drainage” (ARD), and from exposure of mineralization from historic mining practices including leaching of mine wastes, mill tailings, and smelter wastes (also ARD) and from the drainage emanating from mine adits, called “acid mine drainage” (AMD). The result is that most of the caldera area streams are toxic to aquatic life due to high concentrations of Al, Cd, Cu, Fe, Mn, Pb, and Zn as well as low pH and armoring of benthic substrates from metal oxide and hydroxide accumulation.

Nearly all streams in the upper basin above Silverton, San Juan County, plus the Animas main stem as far as Durango were listed "high priority" on the State's 303(d) list of impaired waters in 2000 due to heavy metal contamination. Numerous miles of streams were devoid or severely reduced of aquatic life and habitat. Approximately 1500 abandoned mine sites exist within the Upper Animas watershed, nearly all mined before permits were required. Over half of these are owned by individuals never involved with the mining disturbances while the remaining sites occupy public lands (BLM and USFS). In 2001 monthly numeric standards were adopted by the WQCC based upon the feasibility and anticipated reduction of metal loads through mine site remediation as outlined in the Animas Use Attainability Analysis.

In late 1994 the Animas River Stakeholders Group (ARSG) was founded as a collaboration of private and public entities (Appendix F) with the mission of improving water quality and aquatic habitat throughout the Animas Watershed. Today the group has eighteen years experience in applying a watershed approach to site monitoring, site characterization, remediation feasibility evaluations, and mine site remediation. Most of the founding persons of this diverse group are still active participants. The Stakeholders full body of work, which includes the characterization, evaluation, ranking, and proposed metal reductions through remediation of 67 mine sites within the Upper Animas basin, was presented to the Water Quality Control Commission as the Animas Use Attainability Analysis (UAA)<sup>1</sup>. Of over 1500 mine sites, 33 contributed significant acid mine drainage (AMD) while 34 were major acid rock drainage contributors (ARD). These 67 sources accounted for over 90% of all anthropogenic toxic metal sources. Each of these sites were evaluated and prioritized for remediation purposes. The UAA recommended adoption of “goal-based” stream use classifications and monthly numeric standards based upon anticipated reductions brought about through its comprehensive remediation plan in which sites were characterized, evaluated,

<sup>1</sup> Simon, W, Butler, P, Owen, R, 2001. Use Attainability Analysis for the Animas River Watershed. Animas River Stakeholders Group (presented to Colorado Water Quality Control Commission for the adoption of steam standards). 240p., several appendices, CD ROM w/data.

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and prioritized. The natural sources of metals were also quantified but not considered as having potential or desirability for reduction; thus table based standards were considered inappropriate for some areas and specific times of year. Use Classifications and standards were adopted in 2001 as recommended by ARSG. As a result 27 Total Daily Maximum Loads (TMDL's) for metals and acidity in the stream segments were approved.

By reference, the Upper Animas Watershed Plan incorporates the prioritization of sites completed in the Animas UAA. *The Watershed Plan has been revised and updated as of June 30, 2013. Mineral Creek priorities have not changed in the plan other than to note the projects that have been completed.* During the characterization of mine sites within Mineral Creek, the Bullion King mine waste site only became apparent as a high metal loader upon close examination of the site and leach testing data. The wastes are very high in decomposed iron pyrite, collectable pseudomorphs of limonite after pyrite, and base metals. Leach testing indicated the wastes are a major source of Al and Fe, and a moderate source of base metals as compared to all other mine wastes in the basin. However, the before and after sampling a “small” storm event in 2000 demonstrated the actual leaching of metals from this site (Table 1). Note that lead, a non-compliant and TMDL metal throughout Mineral Creek, concentration increased tenfold. Variations in solubility of the metals are such that a single sampling event such as this does not catch the impact from all metals since their leaching and transport differs over time. But what is clear is that as the stream passes the base of the mine wastes metal concentrations increase and during even a small storm event when surface leaching occurs the impact is quite significant.

Table 1: Leach Test of Mine Waste – 3:1 (D.I. water: mine waste)

	pH	Al ug/l	Cd ug/l	Cu ug/l	Fe ug/l	Mn ug/l	Pb ug/l	Zn ug/l
Leachate	2.56	110,395	1040	2469	1,711,690	32,711	1025	108,206

Table 2: Sept. 21, 2000 Storm Event Sampling (Total Recoverable Concentrations in ug/l)

	pH	Al	Cd	Cu	Fe	Mn	Pb	Zn
Before storm								
Abv. BK		17	<.2	<.6	14.8	2.2	<1.5	3.2
Blw BK		297	1.8	10	1195	234	12.3	445.5
After storm								
Blw BK		1395	2.0	27.8	9240	308.2	131.07	471.9

There is no other recent or legacy mine activity in Porphory Gulch.

## 2.4 – Water Quality Priorities

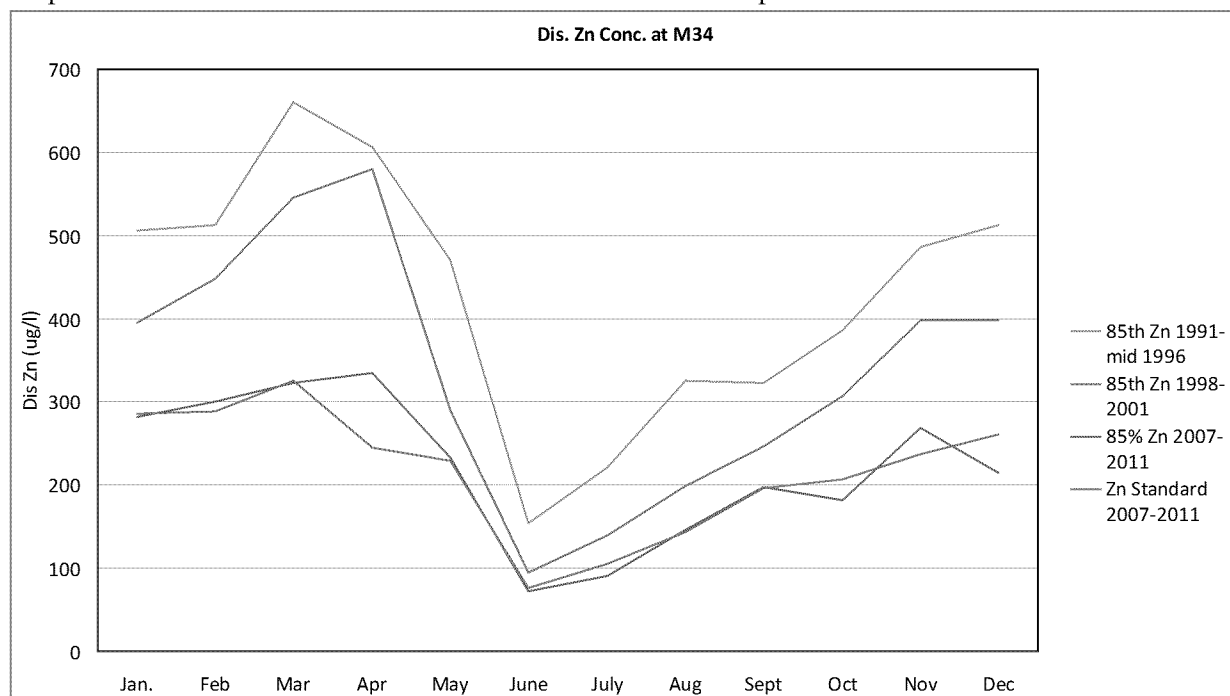
This project is designed to remediate the last large priority mine waste site remaining in the Mineral Creek tributary to the Animas River. According to the 2012 Nonpoint Source Management Plan, projects that address legacy mining impairments are the top priority through 2017. Restoration of nonpoint source impacts in impaired water bodies is also a main objective of the Nonpoint Source Program. As a result many projects over the last 15 years, Mineral Creek is now very close to meeting the 2001 adopted water quality standards.

Collaborative remediation efforts completed throughout the Mineral Creek watershed has resulted in significant, documented water quality improvements as measured at M34, the Mineral Creek gauging station slightly above its confluence with the Animas River. Graphs 1 & 2 illustrate recent dissolved zinc

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concentration and load reductions; reductions of all 7 TMDL metals and acidity are illustrated in Appendix C. Al, Cd, Cu, Mn, and Zn are now in compliance with numeric standards or nearly so. Only Iron and pH will possibly remain out of compliance after this projects completion. The majority of both pH and Iron come from natural sources, including the shallow Paradise mine which is believed to have been driven on a natural acid rock drainage spring. However due to liability concerns ARSG is unable to address this mine or any of the others in Mineral Creek unless Good Samaritan legislation is passed.

Graph 1: Dissolved Zinc Concentrations at M34 at various time periods



Graph 2: Dissolved Zinc load at M34 at various time periods

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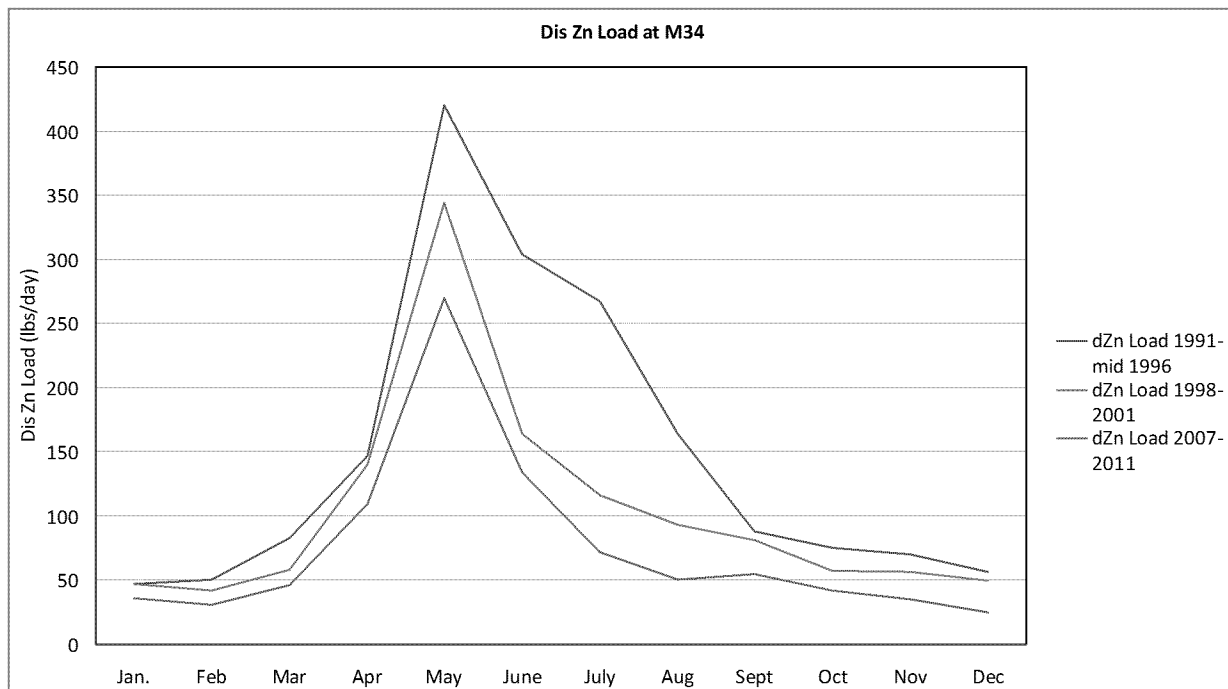


Table 3 provides the target stream segments, their use classification, impairment, and TMDL Status. Due to the present overwhelming quantity of metal loading from Cement Creek into the Upper Animas River effective water quality monitoring for this project will be targeted at sites M06 (mouth of Porphory Gulch, Segment 8) and M34 (mouth of Mineral Creek, Segment 9).

**Table 3: Stream Segments Impacted by the Proposed Project**

Waterbody ID	Beneficial Uses	WQ Impairment	TMDL Status
Animas River-Segment 8 Mineral Cr. headwaters and tribs. Including Porphory Gl.to confl. w/S. Mineral Cr.	Recreation E Agriculture	Metals: Al, Cd, Cu, Fe, Mn, Pb, and Zn. Acidity	TMDL's developed by WQCD based upon ARSG remediation reduction goals.
Animas River-Segment 9 (Mineral Cr.) S. Mineral Cr. To Confl. w/Animas River	Aq Cold Water class 2; Rec E, Agriculture; Water Supply	Metals: Al, Cd, Cu, Fe, Mn, Pb, and Zn. Acidity	TMDL's developed by WQCD based upon ARSG remediation reduction goals.
Animas River-Segment 4a	Aq Cold Water class 2, Rec E Agriculture	Metals: Al, Cd, Cu, Fe, and Zn.	TMDL's developed by WQCD based upon ARSG remediation reduction goals.

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Animas River-Segment 4b	Aq Cold Water class 1, Rec E Agriculture; Water Supply	Metals: Cd, Zn	TMDL's developed by WQCD based upon ARSG remediation reduction goals.
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The Bullion King has been characterized and evaluated by the ARSG Remediation Feasibility Work Group to determine its feasibility and priority for remediation. Since all higher priority mine waste projects have been completed the Bullion King has become our highest remaining priority project for remediation in the Mineral Creek basin (Appendix G – Mine waste site prioritization). Further characterization is necessary however, to ensure that appropriate best management practices (BMP's) are chosen and to better estimate total costs. We believe that this proposed project will lead to goal attainment while engaging locals in voluntary and contractual roles and further demonstrating the effectiveness of implemented BMP's.

## 2.5 - Map of Watershed Locations

Appendix B consists of the following maps and photographs of the area and mine site:

Figure 1: Animas Watershed Stream Segment Map

Figure 2: Gauging Stations and TMDL Segments

Figure 3: Bullion King Mine area map

Figure 4: Bullion King Mine

Figure 5: Bullion King (disposal area against cliff face)

## 3.0 - Project Description

This is the last mine waste site remediation project designed to significantly reduce metal pollution to Mineral Creek and meet the goal based numeric stream standards adopted in 2001. Construction will consist of implementing several BMP's previously demonstrated as effective for in this high altitude setting such as waste consolidation, neutralization, capping, and run-on and run-off controls.

The entire Bullion King Mine site is believed to reside on private property and is considered abandoned; the current owners have not been involved in mining operations. Verbal consent to investigate and plan for remediation has been given from the land owner. The owner will be expected to sign an agreement (Appendix I) that they will maintain the integrity of work accomplished by this project.

Construction will involve the preparation of an on-site repository large enough to accept all consolidated wastes. Top soil will be laid aside for later top covering as a growth medium for native alpine vegetation. The mine wastes at this site have an unusually high amount of fine fault gouge (see Appendix B-Figure 4). We intend to use this substance, plus amendments, to construct a low permeable covering on top of the coarser, highly mineralized waste rock to be placed in the repository. Talus, an impermeable membrane or amendment, and/or soils and native vegetation will provide the final cover. It may be necessary to install a clay liner over the mine wastes if test results of using compacted fault gouge are unsuccessful. This would tend to increase the cost of the project substantially.



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*WQIF funding assistance will allow for more detailed and timely characterization, construction engineering, permitting (RAM) development, and development of bidding documents. With WQIF support we will now be able to accomplish several tasks that will lead to better remediation through additional analysis of the mine wastes. Using an on-site XRF will also give us indications of the volumes of different kinds of waste, neutralization requirements, and what to expect necessary for re-vegetation requirements. We will also be taking pH pastes testing of the different waste types so we can plan re-vegetation efforts. Small test pits of potential repository sites will be dug and evaluated for holding the volume of the wastes as well as potential for run-on hydrological controls. Other 2013-2014 tasks to be accomplished include the completion of a Removal Action Memorandum Agreement (RAM) to limit liability exposure, the choice of BMP's to be implemented, construction tasks, and the development of a bidding document.*

### **3.1 - Environmental and Programmatic Goals**

Environmental Goal: Improve water quality in Mineral Creek by reducing the leaching of metals from the Bullion King Mine site.

The overall project environmental goal is to improve water quality in Mineral Creek to meet specific numeric standards for metals through the implementation of BMP's proven to be effective in this particular high elevation watershed. BMP's will include run on and run off controls, erosion controls, mine waste consolidation into an area specifically developed to minimize future weathering of the wastes, neutralization and compaction of upper layers, plus a final cover of plant substrates, seed, and mulch to provide for a native vegetation cover and/or a talus cover. *Optimization of BMP's to be designed and implemented will now be assured by the WQIF funding which enables additional field condition analyses in 2013 – 2014, including experimental testing of fault gouge as a capping agent, and a growth media, and the testing of other potentially beneficial capping methods. Lessons learned from past remediation projects will be incorporated into the project design.*

Due to the high concentration of Al and Fe from natural sources fish are not expected to ever inhabit Segment 8 of the Mineral Creek mainstem. However it is thought that with the adopted goal attainment benthic macroinvertebrate populations should improve in both Segments 8 and 9 and that brook trout may be able to migrate upstream from Segment 4a of the Animas River through Segment 9 of Mineral Creek where they could enter South Mineral Creek, which is already a trout fishery.

Programmatic Goals:

- 1) Evaluation of the Bullion King Project effectiveness and additional characterization in Arrastra Gulch for feasibility of future remediation.
- 2) Effective project administration and education and outreach.

BMP's will be monitored and evaluated during and after construction to ensure maximum benefits in reduction of metal loads to Mineral Creek as well as how well the program was developed and administered. Water quality monitoring will consist primarily of comparing post remediation conditions to those of the past 20 years at the M34 gauging station (see Appendix C for examples). ARSG has also had an extensive program of benthic macro-invertebrate monitoring throughout the Animas Watershed including 2 locations in Mineral Creek. Sampling events at two locations before implementation and 2 or 3 years after BMP implementation are planned for the evaluation of changing biological conditions. Arrastra Gulch, in segment 3c, is a priority in part due to the availability of targeted funding from a settlement agreement with a mining corporation. Additional characterization in Arrastra Gulch will determine the potential and priority for remediation as compared to other priority sites in the watershed. Through targeted education and outreach, ARSG will demonstrate the effectiveness of implemented

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BMP's to control metals leaching from mine wastes into nearby streams. All fiscal and reporting requirements will be met.

### 3.2 Objectives, Tasks, and Products

**Environmental Goal:** Improve water quality in Mineral Creek by reducing the leaching of metals from the Bullion King mine site.

**Objective 1:** Complete the characterization of on-site remediation opportunities and implement cost-effective BMPs that will minimize the leaching of metals from the site and maximize the life of the remediation.

Task 1: Site investigations for BMPs design and materials selection.

- i. Investigate the remote site conditions for the purpose of identifying the different types and properties of mine wastes, treatment and disposal options, and total project costs.
- ii. Develop landowner cooperation, consent, and maintenance agreement.
- iii. Develop construction plans.
- iv. Develop bid documents.
- v. Develop Environmental Protection Agency Removal Action Memorandum (RAM).
- vi. Award a construction contract to a low and appropriate bidder.

*Products:* The chosen design and costs estimates of the BMPs to be implemented  
Landowner consent and environmental covenant agreement, construction plans, bid documents, RAM, and contractor selection.

Task 2: Construct chosen BMPs to include the consolidation and moving of all wastes into a prepared on-site repository.

- i. Neutralization of much of the wastes (e.g. upper 3 feet).
- ii. Possible amendment of the waste with impervious substances to reduce leaching.
- iii. Application of either growth media or talus, and construction of run-on and run-off controls.

*Products:* BMPs implemented, job logs, annual and final construction reports.

**Programmatic Goal 1:** Evaluation of the Bullion King Project effectiveness and evaluation of remediation potential in Arrastra Gulch.

**Objective 2:** Implement a monitoring and analysis program that will thoroughly evaluate responses to remediation of mine wastes and potential for future remediation.

Task 3: Evaluate remediation feasibility, implementation, and response by:

- i. Analyzing remediation options.
- ii. Monitoring water quality conditions before and after treatment.
- iii. Monitoring benthic macroinvertebrates response.
- iv. Evaluating the suitability and stability of implemented BMP's through photo-documentation and annual observations.

*Products:* Sampling and Analysis Project Plan, semi-annual reports and a final report that will include project evaluation and pollutant load reduction estimates.

Task 4: Evaluate chemical, biological, and physical conditions monitored in Arrastra Gulch with the intention of recognizing practical remediation opportunities.

- i. Create a summary report.

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*Products:* A summary report to be used to support the implementation of practical remediation targets.

**Programmatic Goal 2:** Effective project administration and outreach and education that meets all NPS Program Requirements.

**Objective 4:** Project Administration by the San Juan Resource and Conservation and Development (SJRC&D) and ARSG Coordination Committee.

Task 5: Administer the project to meet all contractual and fiscal obligations.

- i. Match tracking.
- ii. Expense accounting.
- iii. Billing of invoices from ARSG, CDRMS, and construction contractors.
- iv. SJRC&D external audit findings if requested.

*Products:* Periodic reports, match tracking, expense accounting, and billing of invoices from ARSG, CDRMS, and construction contractors. SJRC&D external audit findings if requested.

Task 6: Conduct education and outreach.

- i. Coordinate with stakeholders and ARSG Coordination Committee on project implementation at ARSG monthly meetings.
- ii. Disseminate educational materials to mine site owners, agencies, and other members of the public.
- iii. Provide tours of the site and hold evaluation study sessions.
- iv. Give presentations at local, State, and Regional conferences that explain nonpoint source pollution sources, their consequences and remedies.

*Products:* ARSG meeting summaries, guided field trips, web site coverage, newsletter project reports, presentations at local and regional workshops, articles in publications, newspapers and radio media, inclusion of the project on the ARSG website.

### 3.3 - Environmental Permits

The Bullion King mine site, which is on the Arthur Britton patented mine claim, is surrounded by other patented mine claims all owned by the same persons. Wetlands and surface water drainage will not be impacted and therefore CWA permits will not be required.

There are no known threatened or endangered species on site. However it may be desirable to import soils and/or talus rock from nearby USFS lands. Also minor road repair may be necessary on the access road which is in ownership dispute between San Juan County and the USFS. San Juan County wants the road repaired and may require a County permit, easily obtainable by the construction contractor. But the USFS has indicated that they may require an Environmental Assessment if impacts are significant to their lands in which case an archeology survey, SHPO consultation, and a wildlife consultation for migratory birds, wolverine, and lynx could be anticipated. USFS anticipates that they will address these issues on public property but have suggested that they may want DRMS/ARSG to address the archeological and historical (SHPO) investigations on the private land.

DRMS is currently developing the Removal Action Memorandum for this project. Details are being finalized (Appendix J). *The owner of the property has recently been contacted and verbally has agreed with the remediation concepts proposed. ARSG, in cooperation with DRMS, will attempt to get the owner to sign the State's environmental covenant.*

### 3.4 - Lead Project Sponsor Qualifications

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San Juan Resource, Conservation, and Development (SJRC&D) will serve as the lead sponsor and non-profit 501 C(3) corporation contractor as we have done over the past eighteen years. SJRC&D provides financial oversight, independent accounting, and distributes funds upon documentation and invoicing. The Colorado Division of Reclamation, Mining, and Safety (DRMS), in collaboration with the ARSG, will act as construction project manager.

Since 1994 San Juan RC&D has acted as lead sponsor for over a dozen ARSG projects funded by the NPS program. SJRC&D also takes responsibility for administering grants from a number of other funding sources for the ARSG, including the EPA, BLM, the Southwestern Water Conservation District (SWCD), and the Colorado Dept. of Local Affairs. SJRC&D relies upon the ARSG to provide technical assistance and decisions concerning projects, regulatory compliance, permitting, and remediation development and implementation. The ARSG Coordinator Committee is responsible for the coordination between SJRC&D and ARSG.

Over the years our wide range of participating citizens, mining corporations, and private citizens have used a watershed approach to improving water quality and aquatic habitat in the Animas watershed. This work has been accomplished as a collaborative effort of our participants. Decisions on stream standards, TMDL's, mine site remediation feasibility, and data analysis have been accomplished through rigorous scientific investigations, widespread monitoring, data analysis, public education, and consensus building. In recent years our group's efforts have been focused more on the remediation of priority mine sites selected by consensus of the group. The BLM and USFS have taken lead responsibility for the remediation of public land sites, whereas the ARSG deals primarily, but not exclusively, with privately owned mine sites. Sites that are on both federal and private lands are addressed in partnership with the BLM and USFS.

The arrangement between SJRC&D and the ARSG has resulted in the completion of over fifty remediation projects in the Upper Animas basin (Appendix H). Recent analysis of water quality data at M34 indicates the non-compliant seven metals of concern are now in compliance or nearly so (Appendix C). As a result of this collaboration ARSG has received the National Cooperative Conservation Award by the U.S. Secretary of Interior, the Regional Partnership of the Year Award by the U.S. Forest Service, and other local awards for conservation and environmental stewardship.

ARSG maintains an extensive water quality database for the watershed which is shared openly via the internet on our web site ([www.animasriverstakeholdersgroup.org](http://www.animasriverstakeholdersgroup.org)). Our database is the regions most comprehensive compilation of physical, chemical, and biological conditions within the Animas Watershed.

### **3.5 – BMP Operation and Maintenance**

All BMP's to be used on this project are passive in nature and do not require continued operation. Initial watering following seed and mulch may be necessary; the construction contractor will be responsible for this activity.

A site maintenance agreement between the State or its agent and the landowner should be developed before construction begins. The landowner should take responsibility for maintaining the integrity and function of the BMP's and ARSG will periodically evaluate the site for project effectiveness. Site disturbance after completion of remediation would not be allowed unless it is designed to lead to further potential metal load reductions.

## **4.0 - Coordination Plan**

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#### **4.1 - Lead Project Sponsor and Cooperating Organizations**

See Appendix D

#### **4.2 - Local Support**

Match support for this project will come from active ARSG participants. Primary match will come from the Division of Reclamation Mining and Safety (DRMS), Southwestern Water Conservancy District (SWCD), and Colorado Division of Parks and Wildlife (CPW). In addition significant in-kind match will be provided by individuals participating in project engineering and development, monitoring, evaluation, oversight, and on-site vegetative restoration.

The Coordination Committee (presently comprised of Steve Fearn, Peter Butler, and Bill Simon) will be responsible for match accounting and the tracking of all contributions and invoices.

#### **4.3 - Coordination with Other Projects and Organizations**

We have been fortunate to have maintained strong support from all organizations, agencies, local government, mining corporations, mine owners, and citizens of La Plata and San Juan Counties. Appendix F provides a list of active participants in our collaborative process. ARSG continues to support and participate with other watershed groups in our region such as the Colorado Watershed Assembly, Lake City, San Juan, Pine River, Uncompagre, San Miguel, and Creede watershed groups. We frequently share information and experiences. For instance, ARSG has long sought passage of Good Samaritan legislation (visit our website [www.goodsamaritaninfo.org](http://www.goodsamaritaninfo.org)) and have collaborated with these groups, as well as State and regional groups, to obtain support.

#### **4.4 - Similar Watershed Activities**

There are no other collaborative efforts working directly on watershed issues within the Upper Animas Watershed. The Mountain Studies Institute (MSI) is a separate entity involved in several environmental research studies throughout a more widespread area of the San Juan Mountains. MSI collaborates with and is an active participant in the ARSG.

### **5.0 – Project Evaluation and Data Management**

#### **5.1 - SAPP Development**

Up until 2013 all physical and chemical data has been collected under formerly existing SAPP's approved by the WQCD and EPA. In 2012 a new SAPP was developed by the EPA, in cooperation with the ARSG, to continue water quality monitoring throughout many individual mine sites and river stations in Cement Creek and at the 4 Upper Animas USGS gauging stations CC48, A68, A72, and M34. ARSG will be using the EPA SAPP for this project but we will need to make the following amendments: add the stream site Porphyry Gulch at the confluence with Mineral Creek (M06).

- 1) add M06 for water quality and flow monitoring for opportunistic storm events,
- 2) add M34 and Mineral Creek above S. Fork of Mineral Creek for sampling of benthic macroinvertebrates.

#### **5.2 – Monitoring Strategy**

The strategy to be used for monitoring consists of measuring flow, sampling water quality and sampling benthic macroinvertebrates at appropriate downstream locations, photo documentation of construction activities and BMP functionality over time, and fiscal management. For details see Section 3.2 and the Evaluation Table in Appendix E.

#### **5.3 – Data Management**

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Data derived from this project, as well as normal ARSG data management for the Mineral Creek gauge will be put into the ARSG database that includes all sources of biological and chemical data for the Upper Animas watershed and much of the data for the Lower Animas Watershed. ARSG uses an excel spreadsheet format for storage of all data. For the purposes of conforming to the requirements of this project all new data will be uploaded into the Colorado Data Sharing Network.

## **5.4 - Models**

No models are anticipated.

## **6.0 - Budget**

Due to the high elevation and short work season for this project, costs are difficult to estimate accurately. The first working season will be spent completing the evaluation of the best disposal area, methods of reducing permeability of the consolidated wastes, more accurately determining waste volumes, and completing the work plan and bidding documents. After these items are complete the project will be put out to competitive bidding.

*WQIF funds are available to complete the pre-construction activities necessary to more accurately anticipate costs. ARSG has always taken a conservative approach (high estimate) to making cost estimates, basing them on past experiences and the necessity to avoid cost overruns. We are much more comfortable making cost estimates with this extra funding source providing an extra margin of safety in ensuring that the site characterization and design engineering will be adequate.*

### **6.1 - Budget Table (see Appendix A)**

## **7.0 - Public Involvement**

Public involvement has been a key component of SJRC&D's and ARSG's continuous success over the past 18 years. While the national RC&D program has been abandoned due to budgetary constraints, San Juan RC&D has secured its own funding capability and continues serving the communities of southwest Colorado due primarily to public support and dedicated volunteers who serve on the board of directors.

ARSG remains a broad collaboration of federal, state, and local agencies, mining corporations, environmental advocacy groups, land owners, and citizens that participate on a voluntary basis. To avoid conflicts of representation and voting privileges ARSG intentionally remains a non-entity. Our successes are largely due to widespread access and involvement of all stakeholders. Contrary to what some might expect, decisions of the group have easily been reached by developing trust through using publicly available scientific investigations and a watershed approach to issues. Combined with an easily available forum for public involvement, consensus on issues have been easily reached.

### **7.1 - Process for Public Involvement**

SJRC&D holds open public meetings of the Board of Directors (BOD's) once a month. ARSG coordinators usually attend one or more of these meetings as requested by the BOD's to answer concerns or provide updates. Once a year SJRC&D sets aside a day for the various groups they represent to give presentations and updates on their projects before a more widely publicized forum. Ample opportunity for discussions of the projects follows.

ARSG continues to hold monthly public meetings in Silverton except December. Meetings of the Monitoring Work Group, the Remediation Work Group, and the Technology Work Group meet as needed in either Silverton or Durango. In 2012 several large public meetings have been held in larger venues (Silverton Town Hall and Silverton Rec Center) to get more widespread community input on the ARSG basin-wide post remediation analysis, EPA's analysis of new adit discharges in Cement Creek, and the

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potential of an area in Cement Creek being designated as a Superfund site. The inputs from these meetings are currently being used to update and revise the Animas Watershed Plan, released in draft form in June, 2013.

ARSG maintains a comprehensive website at [www.animasriverstakeholdersgroup.org](http://www.animasriverstakeholdersgroup.org) and the website [www.goodsamaritaninfo.org](http://www.goodsamaritaninfo.org) which describes both non-point and point source issues associated with historic mine site remediation efforts. Many of our participants give individual and group tours of our remediation sites. Recent tours were provided for groups of U.S. and Colorado Senators and Representatives, local government officials and elected representatives, and the Colorado WQCC and WQCD personnel. We also provide yearly training sessions for area rafting guides and hostesses for the Durango and Silverton Narrow Gauge Railroad.

### **Appendix Contents**

- A) 2013 Budget Table – Excel Workbook
- B) Project Maps
- C) Water Quality Graphs at M34
- D) Lead Project Sponsor and Cooperating Organizations
- E) Evaluation Table
- F) ARSG Participation List
- G) Priority Mine Waste Sites
- H) Remediation projects completed

## **Appendix B – Area Maps**

**Figure 1:** Animas Watershed Stream Segment  
Map



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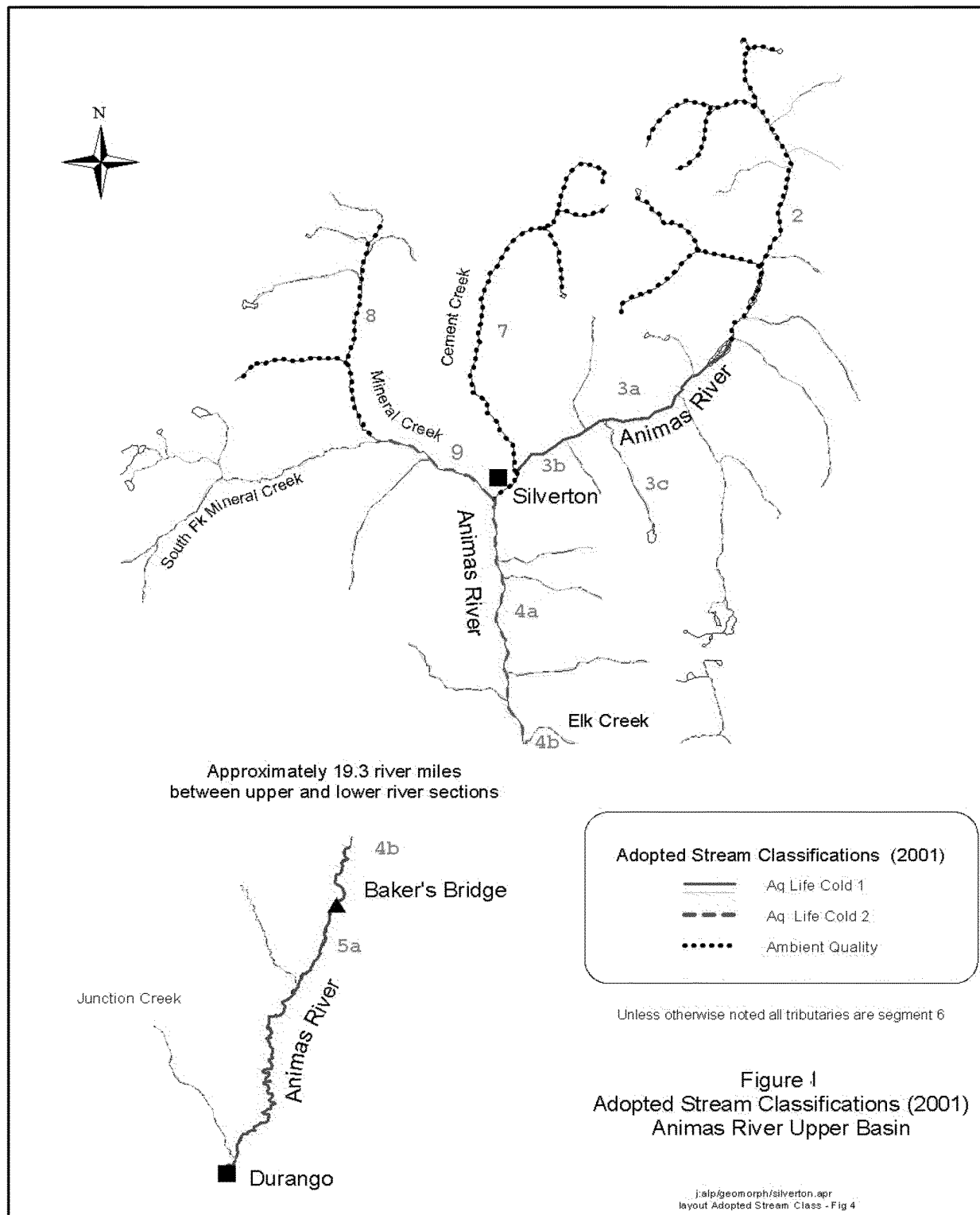
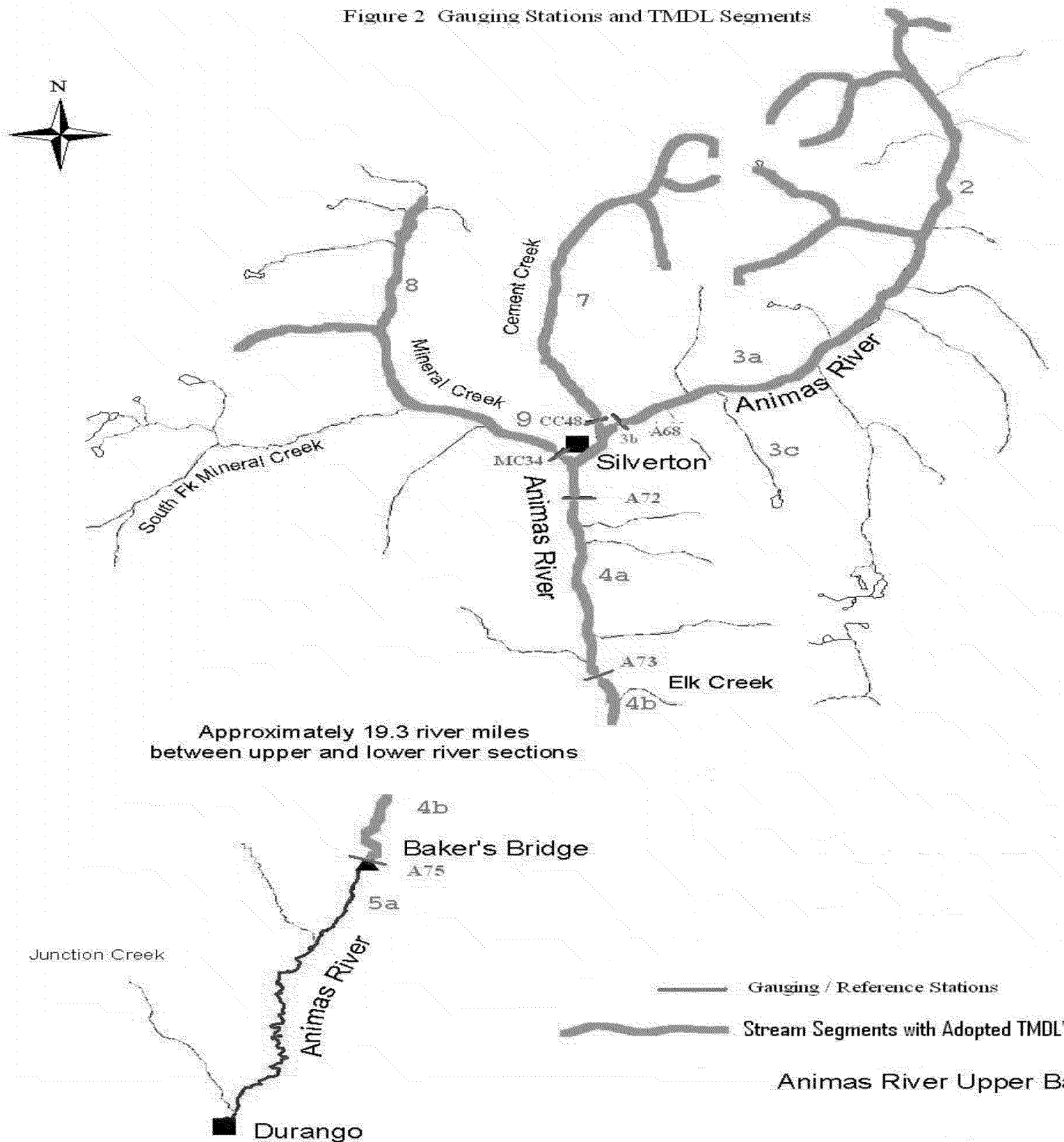
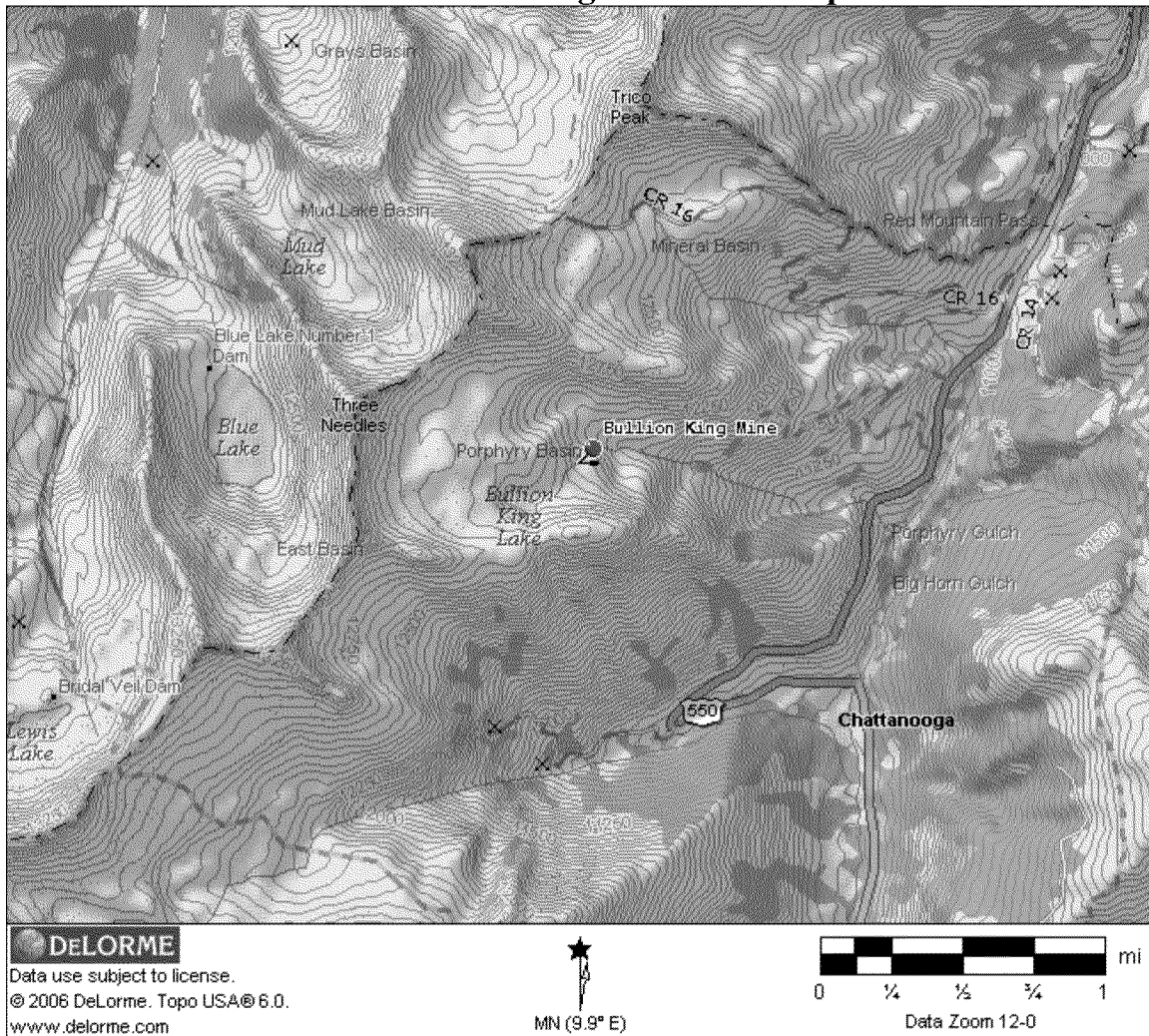


Figure 2 Gauging Stations and TMDL Segments



**Figure 3**  
**Bullion King Mine area map**



**Figure 4**

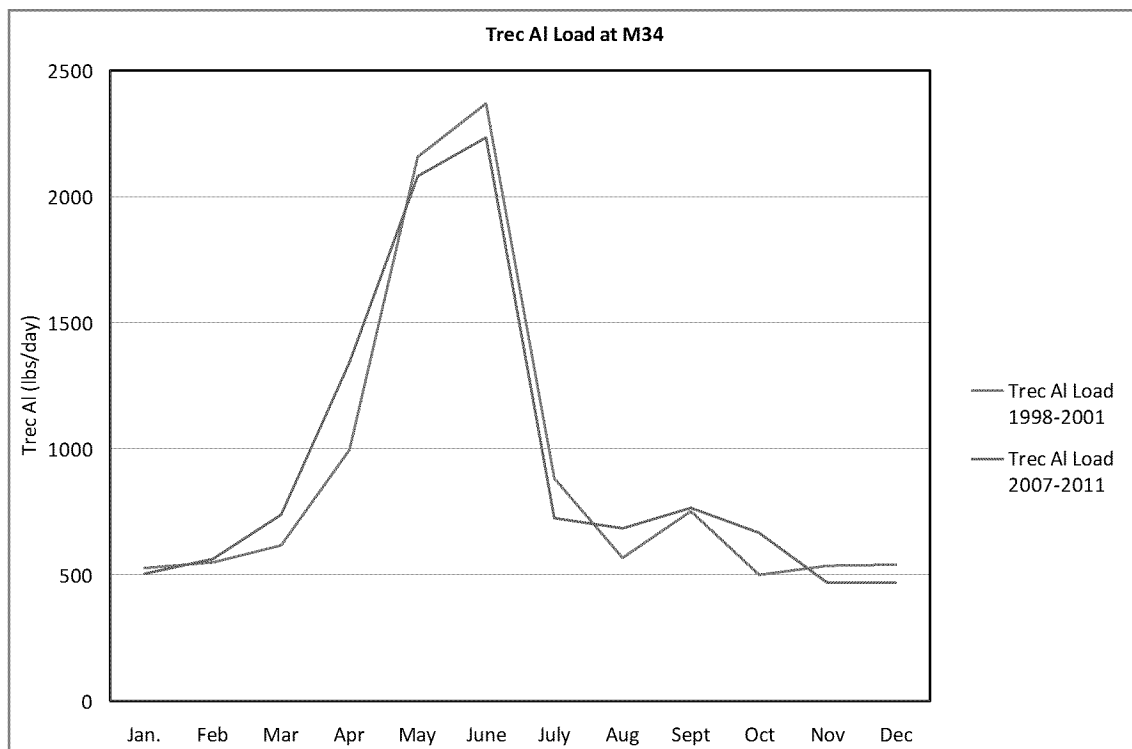
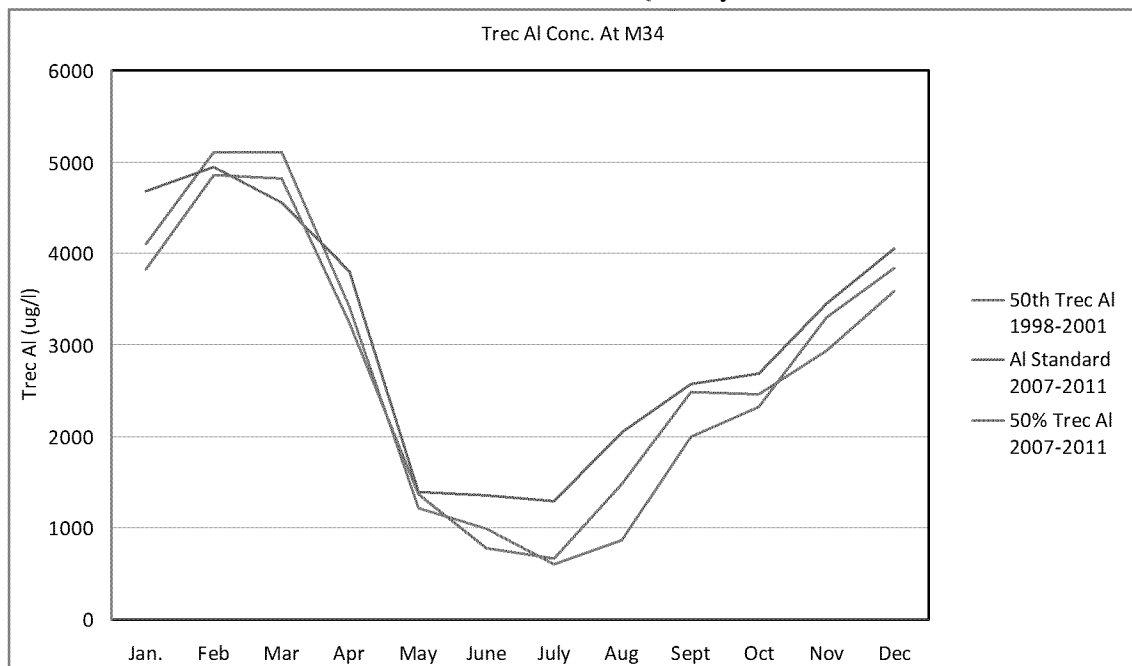
### **Bullion King**



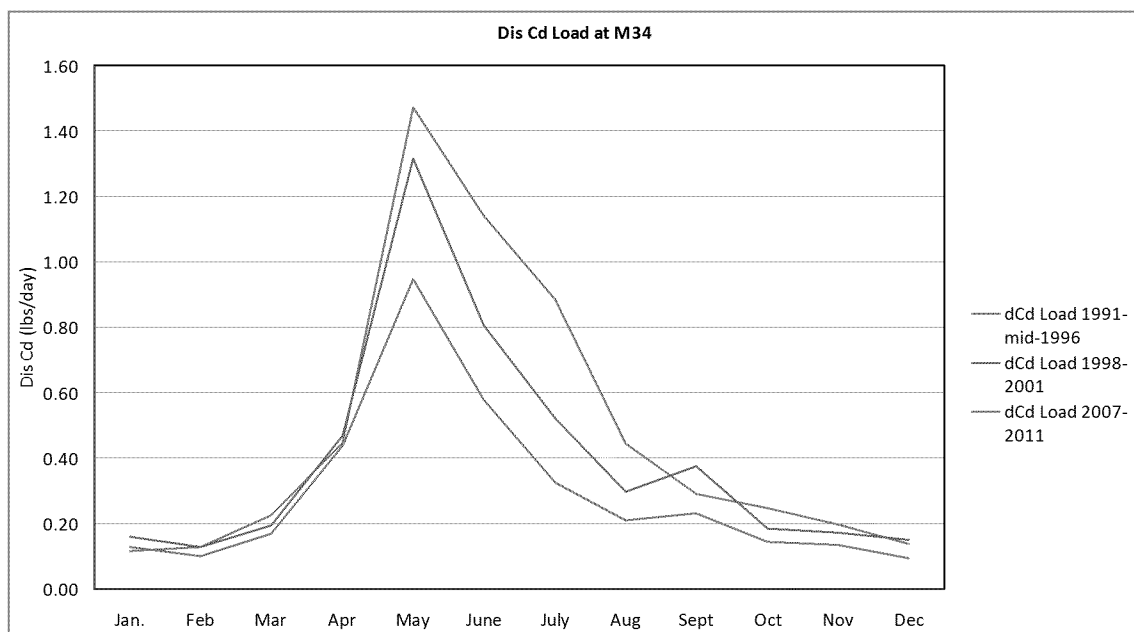
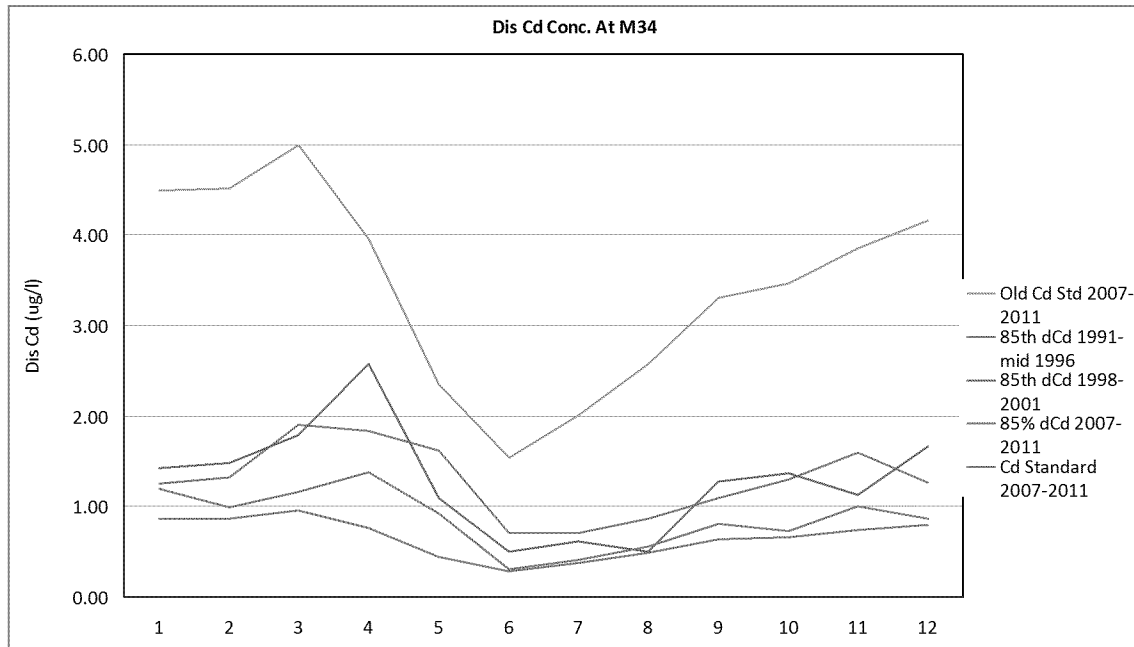
**Figure 5**  
**Bullion King (disposal area against cliff face)**



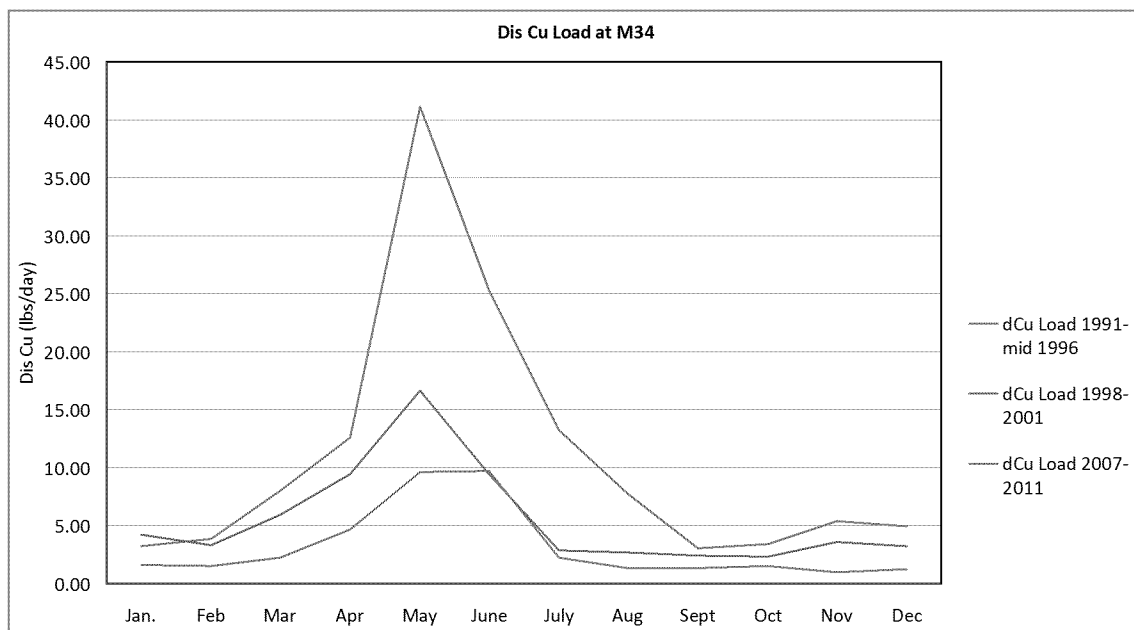
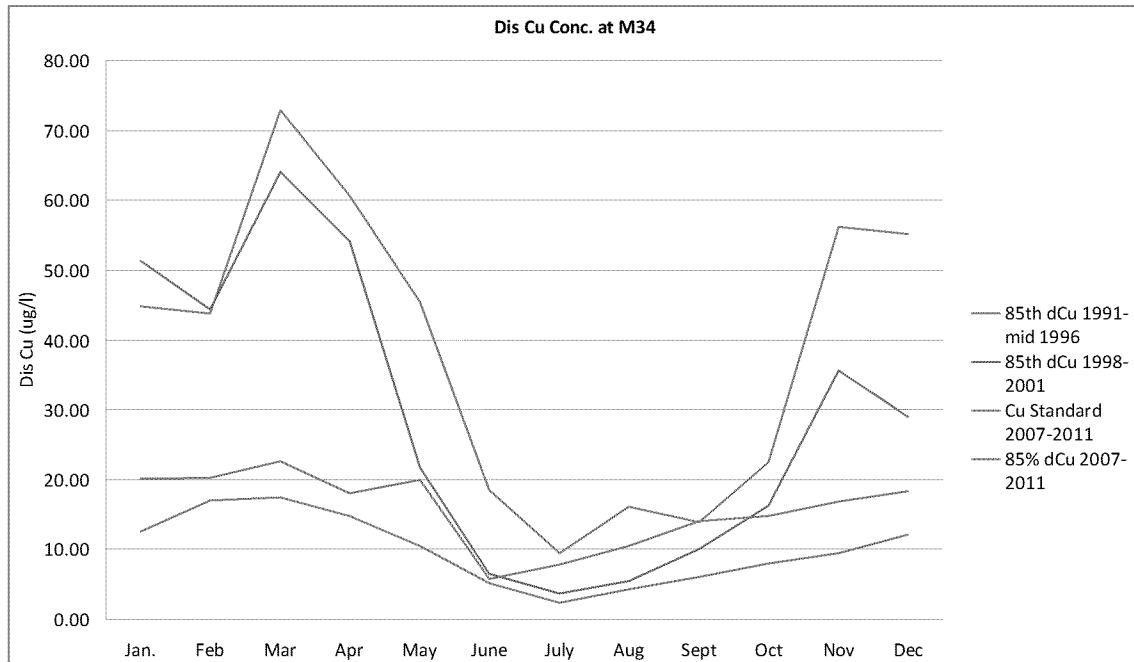
## APPENDIX C Mineral Water Quality at M34



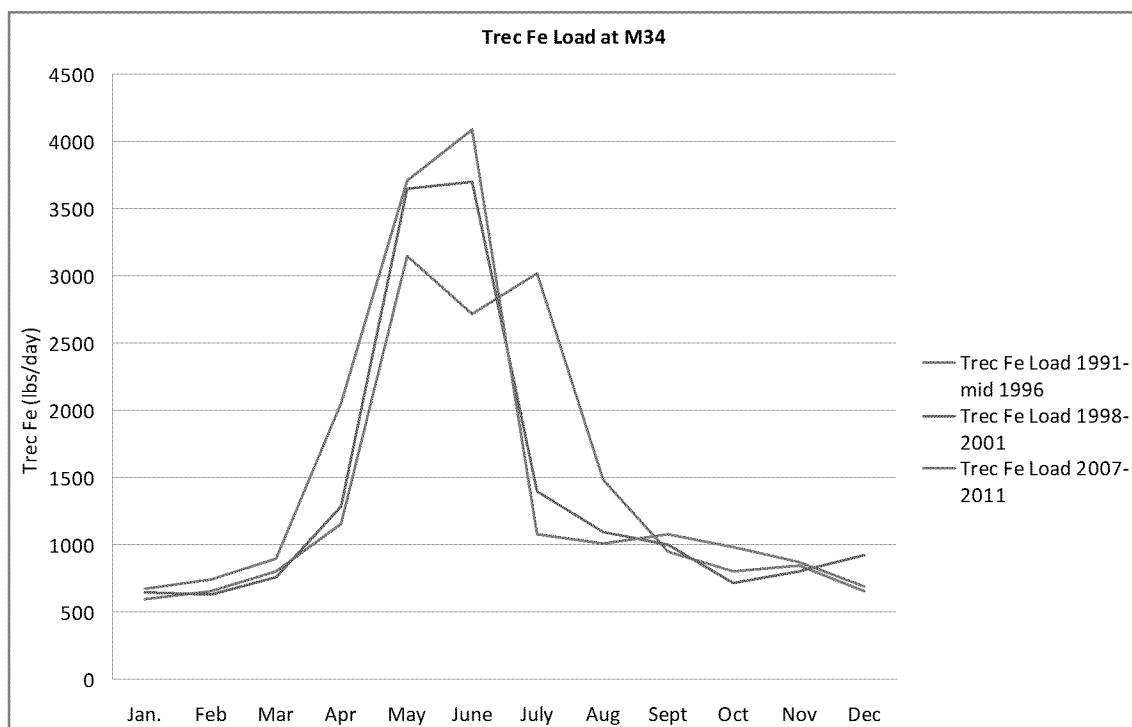
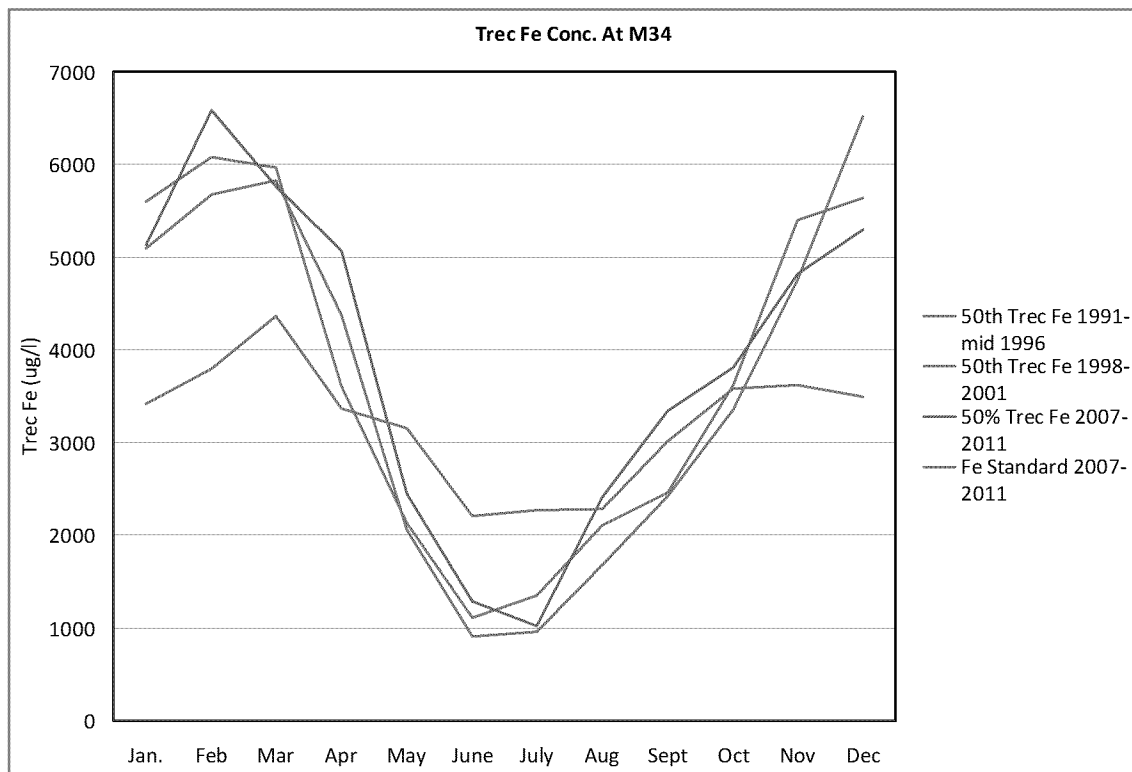
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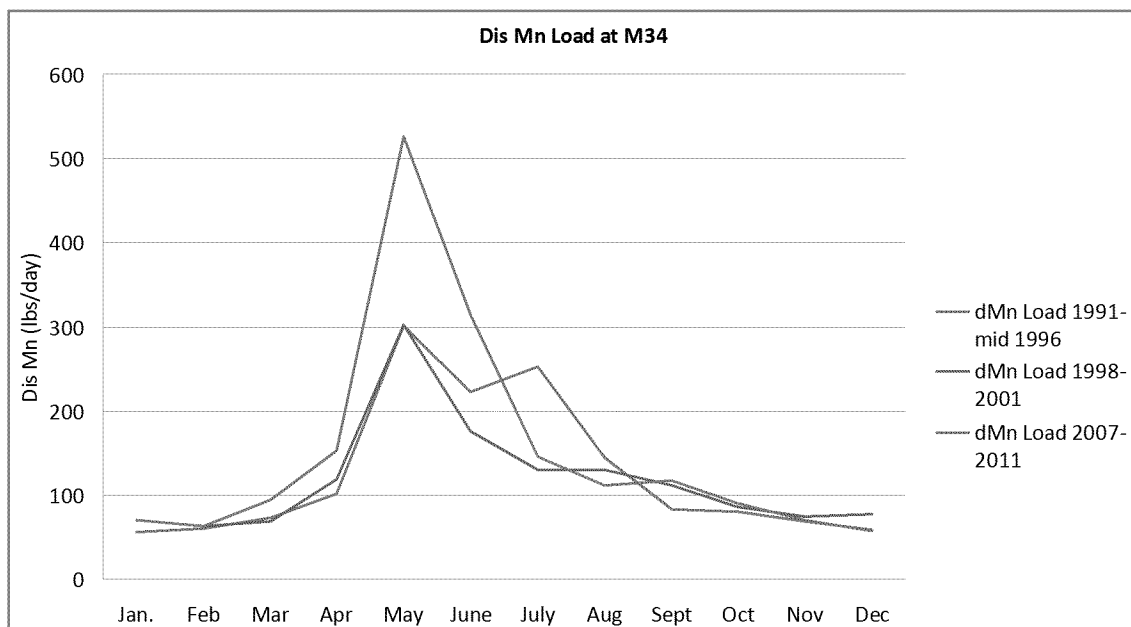
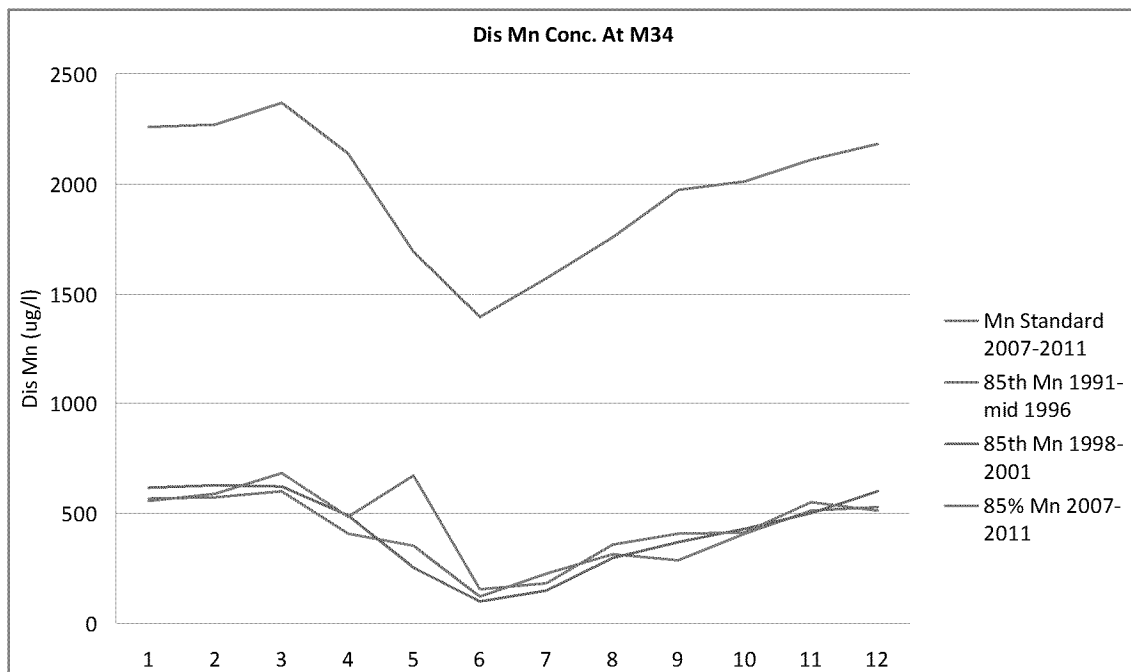


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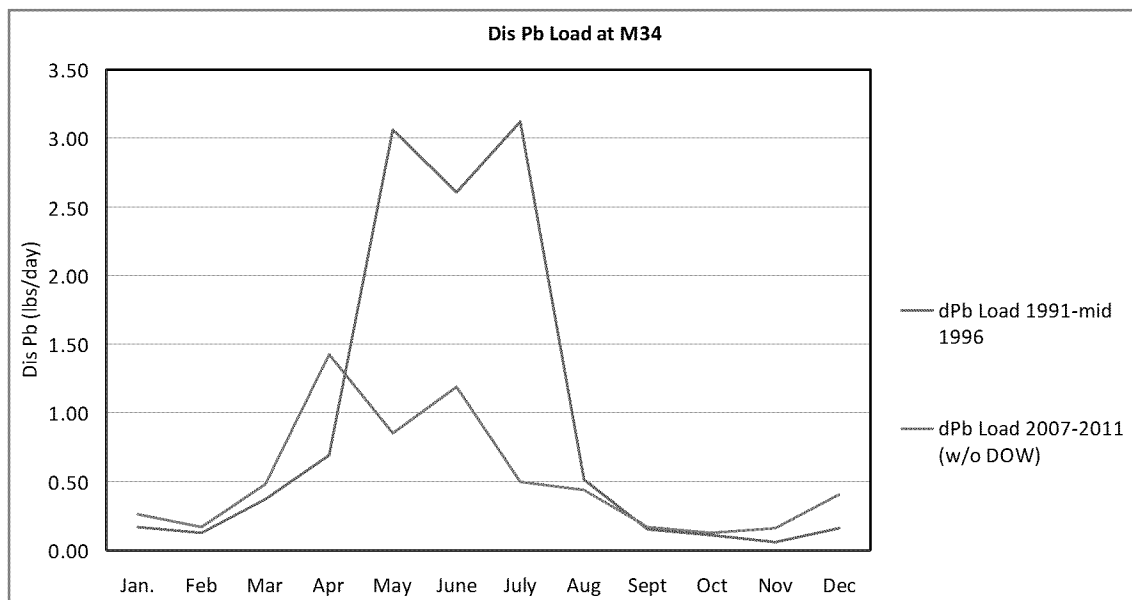
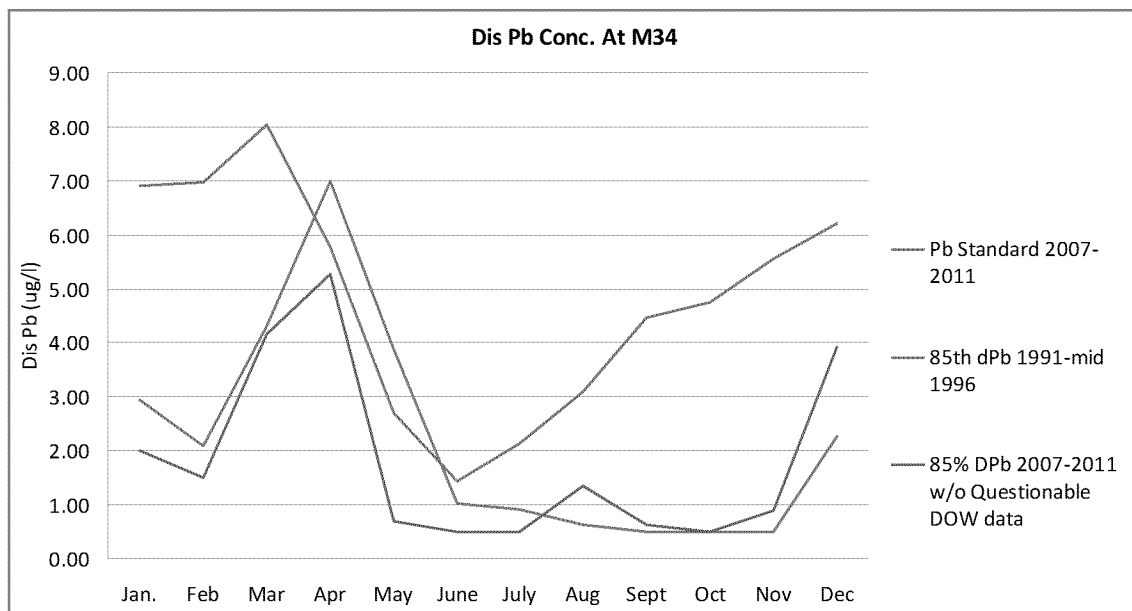




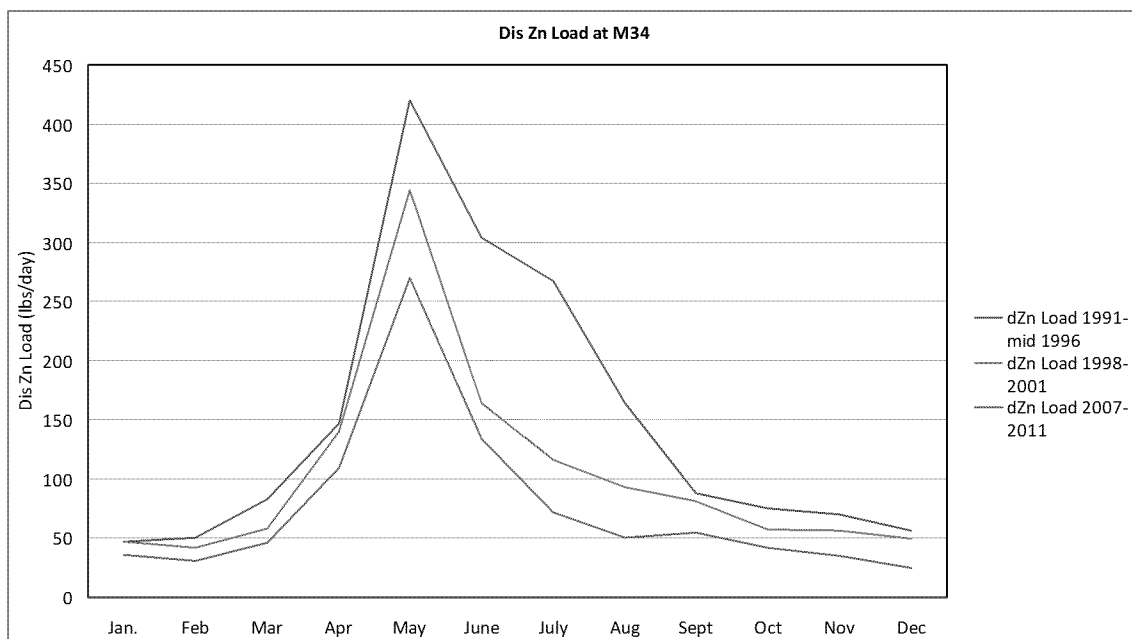
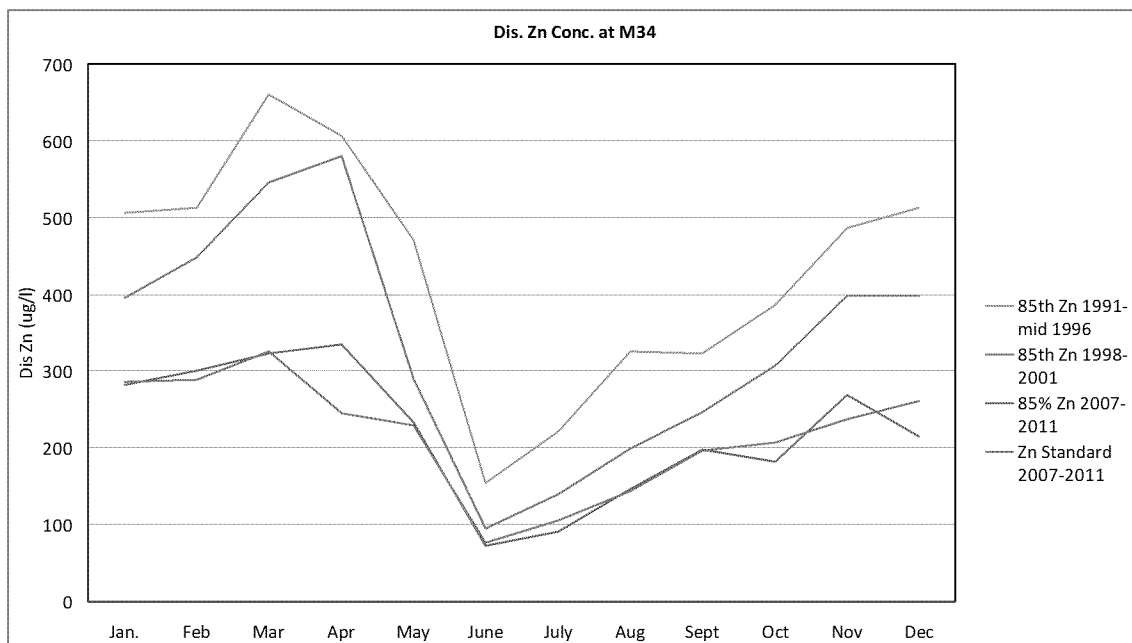
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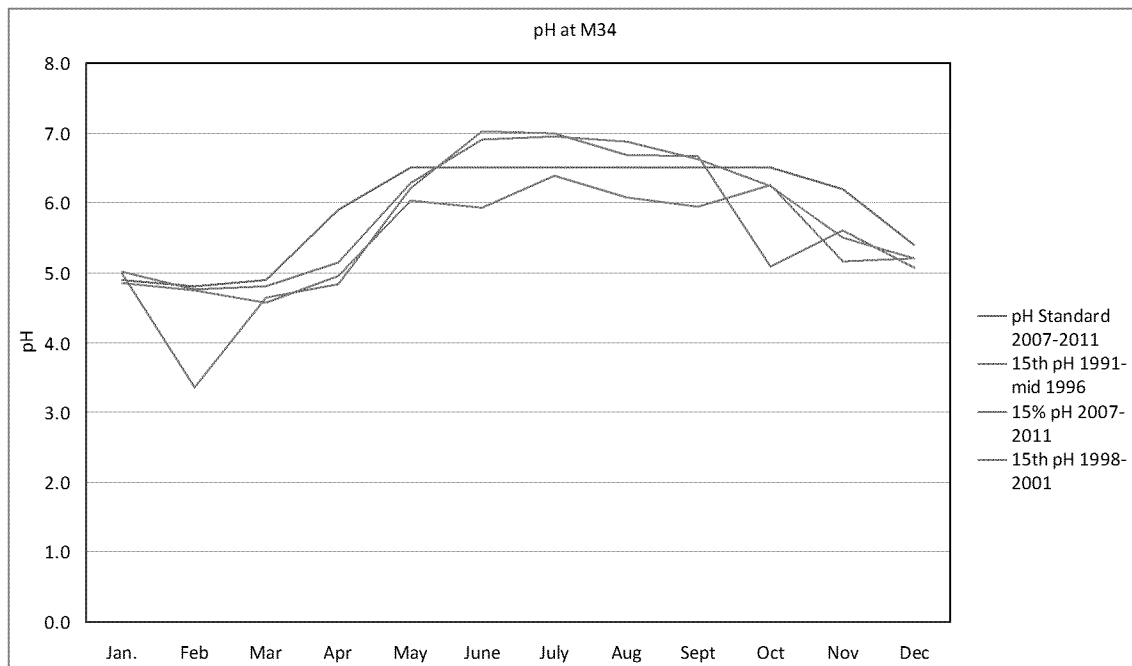
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## Appendix D

### Lead Project Sponsor and Cooperating Organizations

Lead Sponsor			
Agency Name	San Juan Resource Conservation and Development		
Agency Address	San Juan RC&D, 954 E. 2nd. Ave., Suite 104, Durango, CO 81301		
Role/contribution	Funding pass through agency, payment oversight, and auditing.		
Contact Person	Pam Deen	Telephone	(970)382-9371
E-mail address	sjrcd@hotmail.com		

Cooperators			
Agency Name	Animas River Stakeholders Group		
Agency Address	8185 CR 203, Durango, CO 81301		
Role/contribution	Coordination of all Stakeholder activities including the development and implementation of the Bullion King Mine Waste Remediation Project		
Contact Person	William Simon	Telephone	970 385 4138
E-mail address	wsimon@frontier.net		

Cooperators			
Agency Name	USFS		
Agency Address	15 Burnett Ct. , Durango, CO 81301		
Role/contribution	Possible donation of talus and/or soils, Environmental Assessment (if necessary), access road widening oversight, and help with plan development and implementation.		
Contact Person	Kay Zillich	Telephone	970 385 1239
E-mail address	czillich@blm.gov		

Cooperators			
Agency Name	DRMS		
Agency Address	1313 Sherman Street, Denver, CO 80203		
Role/contribution	Development and Construction Contractor; major match contributor		
Contact Person	Kirstin Brown	Telephone	970 903 7889
E-mail address	kirstin.brown@state.co.us		

Cooperators			
Agency Name			
Agency Address			
Role/contribution			
Contact Person		Telephone	
E-mail address			

## Appendix E

### Section 5.2 Evaluation Table

<b>Environmental Goal: Improve water quality in Mineral Creek by reducing the leaching of metals from the Bullion King mine site.</b>				
	<b>Responsible Party</b>	<b>Products and Outcomes</b>	<b>Evaluation Methods</b>	<b>Measure of Success</b>
<b>Objective 1: Complete site characterization, design &amp; engineer BMP's, and implement BMP's</b>				
<b>Task 1 Site investigations for BMP's design</b>	DRMS and/or ARSG	BMP design, engineering, selection, bid documents	Documented and evaluated by ARSG and the co-coordinating committee	Selection of effective BMP's
<b>Task 2: Construct BMPs</b>	DRMS and/or ARSG	BMP construction	Job logs, close out report, photo-documentation; water quality	BMP effectiveness as measured by numeric standard attainment and integrity of BMP's over time (maintenance)
<b>Programmatic Goal 1: Evaluation of the Bullion King Project effectiveness and evaluation of remediation potential in Arrastra Gulch.</b>				
<b>Objective 2; Implement a monitoring and analysis program that will thoroughly evaluate responses to remediation of mine wastes and potential for future remediation.</b>				
<b>Task 3: Evaluate remediation</b> i) Monitor water quality at M34	CPR, SWCD, USGS, ARSG	Post remediation water quality data evaluated; Final Report	SAPP: Water quality data set evaluated for trends	1) Are metal loads at M34 reduced? 2) Is compliance being met?
ii) Monitor project site water quality	DRMS and/or ARSG	Pre and post remediation water quality data set; Final Report	SAPP: Water quality data set evaluated for change before and after project	Are metal loads from Bullion King reduced? Load reduction targets to be refined in the SAPP. Initial targets of Al- 90#/yr; Cd -5.4#/yr.; Cu- 12.6#/yr.; Fe – 8950#/yr.; Mn – 171#/yr.; Zn – 566#/yr.
iii) Monitor benthic macro invertebrates	ARSG	Post remediation data set from Mineral Creek locations; Final Report	SAPP: Compare pre and post remediation bug data sets and CDPHE MMI scores	Do bug indices reflect improved water quality conditions?
iv) Photo-documentation	DRMS & ARSG	Construction and post construction photos	SAPP: Compare photos to project expectations; evaluate problems encountered	Were BMP's 1) adequately constructed, 2) meet long-term useful life expectations
<b>Task 4: Evaluate Arrastra Gulch</b>	ARSG	Final Report including evaluation of the feasibility and locations for remediation; stream standards recommendations	SAPP: Evaluate existing data sets and known conditions using the expertise of ARSG participants in the Technical Work Group	Selection of appropriate remediation targets; determination of appropriate numeric stream standards for Segment 3C.
<b>Programmatic Goal 2: Effective project administration and outreach and education that meets all NPS Program requirements.</b>				
<b>Objective 3: Provide project administration, fiscal management, outreach, and educational opportunities for</b>				

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landowners, mining companies, local, State, and Federal agencies, and interested citizens.				
<b>Task 5: Fiscal Management &amp; Administration</b>	SJRC&D and ARSG Coordinators Committee	1) Match accounting 2) SJRC&D – yearly audit 3) Semi-annual reports and final report	Comparison of actual expenditures to anticipated	Project completion within budget
<b>Task 6: Education and Outreach</b>	SJRC&D and ARSG	Presentations, publications, social media, websites, tours, meetings, reports	Track products	Positive public opinions in support of ARSG activities via feedback on the website and at meetings

**APPENDIX F**  
**PARTICIPANT LIST**  
of the  
**ANIMAS RIVER STAKEHOLDERS GROUP**

***Federal Entities***

Bureau of Reclamation  
Bureau of Land Management  
U.S. Forest Service  
EPA  
U. S. Geological Survey  
Army Corps of Engineers

***Colorado Agencies***

Division of Parks and Wildlife  
Division of Minerals and Geology  
Department of Public Health and  
Environment  
Colorado Riverwatch Program  
Environmental Protection Agency

***Local Agencies***

Southwestern Water Conservation District  
San Juan Resource, Conservation and Development  
Town of Silverton  
City of Durango  
San Juan County  
La Plata County

***Citizens Groups***

San Juan Citizens Alliance  
Mountain Studies Institute  
Trout Unlimited  
River Watch Network, Inc.  
Taxpayers for Animas River  
San Juan County Historical Society

***Private Entities***

Gold King Mining Co.  
BHP Billiton  
Root and Norton Assayers  
Silver Wing Co., Inc.  
Kinross Mining  
Sunnyside Gold Corp.  
Colorado Goldfields  
Durango and Silverton Narrow Gauge Railroad  
Salem Minerals  
Alpine Environmental Services

*Plus numerous citizens from Silverton, Durango, and absentee property owners from throughout the nation*



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## APPENDIX G

### Metal loads from prioritized mine waste rock sites in the Upper Animas Basin

* remediation completed				Load in pounds per year					
Site Name	Acres	% Reduction	Cost \$1000	Al	Cd	Cu	Fe	Mn	Zn
<u>Cement Creek</u>									
*Galena Queen	1.09	90	300	154	36.8	832	6,895	0.0	6137
*Kansas City #2	0.46	40	60	159	7.1	39	3,979	0.0	1172
*Hercules	1.26	90	300	163	30.6	168	6,712	0.0	4711
*Upper Joe & Johns	0.02	40	300	2	0.1	2	19	0.0	23
Grand Mogul - East	0.53	35	300	47	2.0	29	745	0.0	385
*Kansas City #1	0.48	40	60	82	1.2	19	1,618	0.2	282
Black Hawk	0.20	50	60	82	0.5	6	124	0.1	108
Lead Carbonate	0.62	55	300	120	0.8	27	1,228	0.0	179
Henrietta 3	0.86	20	60	217	0.7	107	4,972	0.0	113
Ross Basin	0.15	10	60	9	0.3	18	234	0.0	49
*Lark	0.66	90	60	18	0.8	40	886	0.0	168
Pride of the Rockies	0.05	45	60	7	0.1	0	383	0.1	7
*Henrietta # 7	1.19	40	300	101	0.8	25	1,685	0.0	159
Mogul	1.16	35	300	51	1.2	32	942	0.0	261
<b>Cement Creek Total</b>	8.72			1,210	83.1	1,343	30,421	0.5	13,754
<u>Mineral Creek</u>									
*Brooklyn	0.25	90	300	58	0.8	8	993	117	118
Bullion King:Lower	0.86	90	300	641	6.0	14	9,945	190	629
*Upper Browns Trench	0.11	40	10	27	0.1	8	198	3	9
*Congress Shaft	0.35	40	60	11	0.2	16	109	11	20
*San Antonio	.33	40	60	211	4	139	3826	13	532
*Brooklyn Upper	2.57	20	60	661	3.1	38	9,909	176	163
*Upper Browns	0.51	90	60	82	0.3	5	1,610	6	25
*Little Dora	1.39	30	300	94	0.4	43	452	471	66
*Brooklyn Lower	0.86	20	60	110	0.6	9	672	122	105
<b>Mineral Creek Total</b>	7.33			1,684	11.5	142	23,888	1,095	1,135
<u>Animas above Eureka</u>									
Ben Butler	0.34	40	300	28	0.8	8	225	1	165
Silver Wing	1.21	50	60	98	1.0	123	393	172	131
Tom Moore	0.19	90	60	15	0.3	1	8	43	73
Eagle	0.07	90	60	1	0.1	1	0	7	18
*Lucky Jack	0.70	90	60	16	0.6	3	14	32	95
<b>Animas above Eureka Total</b>	3			157	2.8	136	639	256	482
<u>Animas below Eureka</u>									
Clipper	0.09	90	60	6	0.2	7	80	57	70
Buffalo Boy	0.38	90	60	17	0.8	24	13	73	141
*Ben Franklin	0.37	90	60	81	0.4	13	612	99	95
Caledonia	0.57	30	60	23	1.0	15	1	50	255
Sunnyside	2.50	90	1,000	40	2.3	10	0	536	664
<b>Animas below Eureka Total</b>	4			168	4.6	69	706	815	1,224
<b>GRAND TOTAL</b>	22			3,219	102	1,691	55,655	2,167	16,595

**APPENDIX H**  
**Remediation Projects Completed**  
**Summary of Reclamation Projects in the Upper Animas River Basin**  
**(Updated 10/31/2011)**

(1) Project Sponsor	(2) Project Site Name	(3) Location	(4) Type of Remediation	(5) Project Timeframe	(6) Funding (incl. in-kind match)	(7) Improvements (actual or anticipated)
Sunnyside Gold Corp.	Lead Carbonate Millsite	Gladstone on bank of S. Fork of Cement Creek	Removal of 27,000 yards of tailings from streambank	Completed 1991	SGC: \$163,000	Reduce loading of metals and erosion transport of tailings
Sunnyside Gold Corp.	Mayflower Mill – Tailings Ponds #1, #2 and #3	Mayflower Mill complex near Boulder Creek and Animas River	Re-contour inactive tailings ponds and cap. 625,000 yards of tailings and overburden moved.	Completed 1991-1992	SGC: \$1,755,000	Mined land reclamation –reduce loading of metals and erosion transport of tailings
Sunnyside Gold Corp.	Lake Emma Sunnyside Basin	Sunnyside Basin headwaters of Eureka Creek	Fill mine subsidence, remove 240,000 yards mine waste and re-contour disturbances.	Completed 1991-1993	SGC: \$911,000	Mined land reclamation and reduce loading of metals
Sunnyside Gold Corp.	American Tunnel waste dump	Gladstone on bank of S. Fork of Cement Creek	Remove 90,000 yards of waste dump and underlying historic tailings	Completed 1995	SGC: \$766,500	Mined land reclamation and reduce loading of metals and erosion transport of tailings
Sunnyside Gold Corp.	Eureka Townsite	On banks and In floodplain of Animas River	Remove 112,000 yards of tailings	Completed 1996	SGC: \$843,000	Reduce loading of metals and erosion transport of tailings
Sunnyside Gold Corp.	Gladstone	Cement Creek at Gladstone	Divert and treat Cement Creek to mitigate any short term impacts of reclamation projects	8/96-5/99, 11/99-12/99	SGC: \$901,000	Reduce loading to Animas River to offset any short term impacts of reclamation of other sites.
Sunnyside Gold Corp.	Boulder Creek Tailings	Flood plain of Boulder Cr. and the Animas River	Remove 5700 yards of tailings	Completed 1997	SGC: \$32,500	Reduce loading of metals and erosion transport of tailings
Sunnyside	Ransom adit	Eureka townsite	Bulkhead seal to stop deep	Completed	SGC: \$85,400	Restore hydrologic regime and

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Gold Corp.		above old mill foundation	mine drainage and reclaim portal	1997		reduce rate of ore oxidation by placing mine workings under water to reduce metal loading.
Sunnyside Gold Corp.	Gold Prince mine waste and tailings	Headwaters of Placer Gulch	Bulkhead seals to stop deep mine drainage. Consolidate mine waste and tailings (moved 6000 yards) and construct upland diversions	Completed 1996-1997	SGC: \$151,000	Reduce exposure to water to reduce metal loading
Sunnyside Gold Corp.	Longfellow-Koehler	Headwaters of Mineral Creek near top of Red Mountain Pass	Remove Koehler dump (32,100 yards), consolidate Junction Tunnel dump and Longfellow dump and cap. Capture adit drainages. Construct diversions. Feasibility study of wetland treatment of Koehler drainage.	Completed 1996-1997	SGC: \$580,000	Reduce metal loading and erosion transport of mine waste
Sunnyside Gold Corp.	Pride of the West tailings	Howardsville near confluence of Cunningham Creek with Animas River	Remove 84,000 yards of tailings	Completed 1997	SGC: \$490,500 TUSCO: \$14,000	Reduce metal loading and transport of tailings by erosion
Sunnyside Gold Corp.	Sunnyside Mine	Sunnyside Mine Lake Emma Area	Inject 652 tons of hydrated lime into the Sunnyside Mine pool to provide increased alkalinity and improve initial mine pool conditions	Completed 1996-1997	SGC: \$313,000	Improve initial conditions as water table is restored through bulkheading to stop mine drainage
Sunnyside Gold Corp.	Mayflower Upland Hydrological Control	Mayflower Mill and Tailings Pond #1 area near Silverton	Capture and divert three upland drainages that were going sub-surface up-gradient of the mill and TP #1 facilities	Completed 1998-1999	SGC: \$186,000	Minimize potential for contact of runoff with tailings and reduce potential for metal loading
Sunnyside Gold Corp.	TP #4 drainage modification	Drainage ditch between Hwy. 110 and TP #4 near Silverton and Animas R.	Install lined diversion ditch to capture surface runoff and prevent infiltration through tailings material	Completed 1999	SGC: \$72,000	Minimize potential for contact of runoff with tailings and reduce potential for metal loading
Sunnyside Gold	TP #4 upland groundwater	Up-gradient from Tailings Pond #4	Capture groundwater and divert around tailings impoundment	Completed 1993-1995,	SGC: \$409,000	Minimize potential for contact of groundwater with tailings and reduce

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Corp.	diversion	near Silverton		1999		potential for metal loading
Sunnyside Gold Corp.	Sunnyside Mine hydraulic seal project	Sunnyside Mine	Bulkhead placement in Sunnyside Mine to restore hydrologic regime to approximate pre-mining and eliminate drainage from adits (6 bulkheads)	Completed 1992-1996	SGC: \$2,346,000	Place mine workings under water to reduce oxidation, restore groundwater movement around mine workings and eliminate need for perpetual water treatment
Sunnyside Gold Corp.	Power Plant Flats	Power Plant Flats, Animas River floodplain	Removal of mill tailings from floodplain	Completed 2003	SGC: \$ ?	Excavate buried tailings and dispose into Mayflower Tailings Pond #4
Sunnyside Gold Corp.	Mogul Mine Bulkhead	Mogul Mine, Upper Cement Crk.	Stop discharge of AMD from Mogul Mine	Summer, 2003	SGC: \$?	Reduce metal loading to Upper Cement Crk
Sunnyside Gold Corp.	Kohler Mine Bulkhead	Kohler Mine, Headwaters of Mineral Crk	Stop discharge of AMD from Kohler mine	Summer, 2003	SGC: \$	Reduce metal loading to Mineral Crk. Headwaters
Sunnyside Gold Corp.	Reactive Wall	Animas floodplain below MF. Tailings #4	Treat contaminated groundwater before entering Animas River	Fall, 2003	SGC: \$	Reduce metal loading to Animas River
Gold King Mines Corp	Gold King Mine	Gladstone, N. Fork of Cement Creek	Hydrologic controls for workings and mine waste	1998	Gold King: \$117,300	Reduce metal loading to North Fork of Cement Creek
Gold King Mines Corp	Gold King Mine discharge	Gold King discharge treatment	Pipe mine discharge to Gladstone to actively treat	2002	Gold King: \$ ?	Reduce metal loading to Upper Cement Crk.
Silver Wing Mining Co	Silver Wing	Animas river, about 1.5 mile above Eureka	Collect AMD, hydrological controls	1995	Silver Wing \$7,000	Remove AMD from dump, reduce metals loading
Office of Surface Mining	Galena Queen	Prospect Gulch	Waste consolidation & hydrological controls	1998	Office of Surface Mining: \$10,000	Reduce surface water leaching of toxic metals
Silver Wing Mining Co	Silver Wing	Animas River, about 1.5 miles above Eureka	Anoxic Drain, settling pond, bioreactor	1999-2000	<b>NPS 319Funds:</b> \$216,000. St. Severance tax: \$144,000	Reduce metal loading to the Animas River.
San Juan	Carbon	Headwaters of	Removal of 1,900 cubic yards	Phase 1	<b>NPS 319</b>	Reduce loading of metals especially

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RC & D (ARSG)	Lakes Mine Dump	Mineral Creek East of Red Mountain Pass	of waste rock from stream channel	–completed 1999	<b>Funds:</b> \$72,000 ARSG match: \$62,800	Cadmium, Copper, Iron, Lead, Manganese, and Zinc
San Juan RC&D (ARSG)	Galena Queen and Hercules	Prospect Gulch	Waste Removal, hydrologic controls, amendments, revegetation.	2001	NPS 319 Funds: \$94,800 Mineral Sev: \$90,000	Elimination of surface water leaching of toxic metals. Post remediation monitoring begins in 2002.
San Juan RC & D (ARSG)	Carbon Lakes Mine Waste Phase II Part 1	Headwaters of Mineral Creek East of Red Mountain Pass	Complete removal of waste rock from stream channel	2001 season	<b>NPS 319 Funds:</b> \$38,000 ARSG Match: \$51,000	Reduce loading of metals to Animas River, restore stream channel, revegetate
San Juan RC & D (ARSG)	Carbon Lakes Phase II, Part 1	Headwaters of Mineral Creek East of Red Mountain Pass	Removal and disposal of 3000 tons of <u>Congress Mine Dump</u> wastes	2001 season	<b>NPS 319 Funds:</b> \$38,500 ARSG Match: \$42,500	Reduce loading of metals to Animas River by beginning the removal of mine wastes.
San Juan RC & D (ARSG)	Carbon Lakes Phase II, Part 2	San Antonio & Kohler Tunnel infiltration control	Infiltration Control: Purchased Carbon Lakes Trans-basin diversion rights; abandoned ditch	2001 season	<b>NPS 319 Funds:</b> \$50,000 ARSG Match: \$33,333	Reduce water infiltration to the San Antonio and Koehler Mines; reduce AMD
San Juan RC & D (ARSG)	Red Mtn. Project	Carbon Lakes Ditch Restoration	Ditch, Wetland and Stream Restoration	2003	SWWCD: \$5,000; USFS: \$12,400	Return Mineral Crk headwaters to natural hydrology; erosion controls; restoration of transbasin diversion ditch; wetland restoration.
San Juan RC & D (ARSG)	Red Mtn. Project	Congress Mine, Mineral Crk. headwaters	Complete removal of Congress mine wastes	2003	<b>NPS 319:</b> \$174,000; July, 2003; St. Min. Severance Tax: \$ ?	Reduce metal loading to Animas River by removal of mine wastes and benefaction.
San Juan RC & D (ARSG)	Red Mtn. Project	San Antonio Mine Waste Control project	Hydrological controls, remove wastes from stream, consolidation, neutralization, revegetation	2004	Ca. \$80,000; 40% match from Silver Wing Co. disposal fees.	Reduce metal loading and acidity to Mineral Creek; stabilize site, restore streambed
San Juan RC & D (ARSG)	Handies Peak Project	Lucky Jack Mine wastes and drainage	Hydrological controls, remove wastes from fen, consolidation, neutralization, revegetation; adit and shaft closures	2004	Ca. \$75,000; match from Co. Mineral Severance	Reduce metal loading and acidity to Upper Animas River; uncover fen and restore

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San Juan RC & D (ARSG)	Handies Peak Project	Upper Lucky Jack Mine wastes and drainage	Consolidation, neutralization, & revegetation of waste dump; clean streambed of wastes	2005	Ca. \$13,095; match from Co. Mineral Severance	Reduce metal loading and acidity to Upper Animas River from leaching mine wastes partially residing in stream
San Juan RC & D (ARSG)	Infiltration Control Project	Pride of the West Mine Open Stopes	Combined safety and infiltration closure of 2 large open stopes & 1 raise.	2005	Ca 700,000; Min. Severance; NPS =\$125K; Match=\$84K	Reduced surface water infiltration into mine to reduce metal loading at mine discharge.
San Juan RC & D (ARSG)	Priority Waste Site	Kansas City #1, 2, and 3 mines	Safety closure, mine waste consolidation and burial; revegetation; run-on/off controls.	2006	Ca 175,000; Mineral Severance, NPS, DMG safety pro	Reduced surface water leaching of mine wastes.
San Juan RC & D (ARSG)	Red Mtn. Project	Upper Browns trench and mine	mine waste consolidation and burial; revegetation; run-on/off controls.	2006	\$62,000 NPS \$41,333 match	. Reduced surface water leaching of mine wastes
San Juan RC & D (ARSG)	Silver Ledge Project	Mineral Creek	Remove mine wastes from creek, consolidation in repository; fly ash; run on and run-off controls, some reveg.	2010		
San Juan RC & D (ARSG)	Koehler Mine fracture grouting	Mineral Creek	Install new portal, rehabilitate mine drift	2010		
San Juan RC & D (ARSG)	Koehler Mine fracture grouting	Mineral Creek	Pressure grout fractures around existing bulkhead	2011		
Anglo Saxon, Inc	Anglo Saxon/Porcupine Mines	Cement Creek	Determine water pressure behind 2 closed portals	2009	\$14,000 NPS \$10,000 Anglo Saxon, Inc.	Characterization for evaluation of bulkheads in mines
Mining Remedial Recovery	Sunbank Group	Placer Gulch	Anoxic drain, settling pond, waste consolidation, bulkhead	1995	NPS 319 Funds: \$58,000 MRRC: 38,500	Raise pH from draining adit, reduce metal loading from adits and mine waste
Salem Minerals	Mammoth Tunnel	North Fork of Cement Creek	Settling ponds for mine drainage	1999	<b>NPS 319 Funds:</b> \$10,050. Salem Minerals:	Focused on reductions of iron to Cement Creek

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					\$6,700	
Office of Surface Mining	Galena Queen	Prospect Gulch	Waste consolidation & hydrological controls	1998	Office of Surface Mining: \$10,000	Reduce surface water leaching of toxic metals
U.S. BLM	Joe & John Tunnel	Prospect Gulch	Mine drainage collection and diversion	1998-1999	BLM: \$36,000	Collect AMD for later treatment project development
U.S. BLM	Lark Mine	Prospect Gulch	AMD collection, hydrological controls	1999	BLM: \$17,800	Collect AMD for possible treatment, remove surface water from site
U.S. BLM	Forest Queen	Animas near Eureka	AMD collection and passive wetland treatment	1998-1999	BLM: \$290,000	Reduce metal loading to Animas River
U.S. BLM	Mayday Mine	Cement Creek	Hydrological controls, cap top of mine waste pile	1998-1999	BLM: \$87,000	Reduce surface water leaching of toxic metals
U.S. BLM	Lackawanna Tailings	Animas near Silverton	Removal of tailings from flood plain to Mayday dump for consolidation and capping.	2000	BLM: \$300,000	Reduce metal loading to Animas River
U.S.BLM	Elk Tunnel	Cement Crk	Passive treatment of mine discharge	2003	BLM: \$110,000	Reduce Fe loading to Cement Crk
U.S.BLM & Duke Energy	Henrietta Mine 6 & 7 levels	Prospect Gulch	Mine waste consolidation, neutralization, clay cap, top soil, revegetation	2004	Duke Energy, \$500,000; BLM \$unknown	Reduce metals and acidity in Prospect and Cement Creeks
U.S.BLM	Upper Joe & John & Lark mines	Prospect Gulch	Consolidation of mine wastes from 2 mines sites into one lined repository	2006-7	BLM: >\$600,000	Reduce Fe, Zn, Cu, Cd, Pb loading to Cement Crk
			Repository Repairs	2011	\$24,000	
U.S.BLM	Lark	Prospect Gulch	Repair damages to access road	2010		
U.S.BLM	Eviline	Cement Creek	Construct 0 valent iron treatment system; road access	2010		
U.S.BLM	Lark	Prospect Gulch	Repair repository migrating cover; reveg.	2011		
U.S.BLM	Eviline	Cement Creek	Test water treatment media Remove failed media; replace	2010 2011	BLM \$110,000 BLM	Test treatment media and reduce metal loading to Cement Creek
U.S. F.S.	Bonner Mine	North Fork of Mineral Creek	Waste removal and consolidation; capture mine drainage and reroute	2000	F. S.: \$63,384	Reduce metal loading ot N. Fork Mineral Creek from mine waste and draining adit

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U.S. F.S.	Brooklyn Mine	Browns Gulch – tributary of Mineral Creek	Mine waste removal and disposal in pit w/impervious cap.	2004	F. S.: \$800,000	Reduce metal and acidity from leaching into Mineral Creek.
U.S. F.S.	Bonner Mine	North Fork of Mineral Creek	Small scale test of biochar for metals removal of AMD	2011	F.S. \$ ? MSI \$ ?	



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